UNITED STATES DEPARTMENT OF AGRICULTURE

Dietary Patterns with Ultra-Processed Foods and Growth, Body Composition, and Risk of Obesity: A Systematic Review

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Plain-language summary

What is the question?
The question is: What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity? The population of interest included infants and young children up to age 24 months, children and adolescents, adults and older adults, individuals during pregnancy, and individuals during postpartum.

Why was this question asked?
This systematic review was conducted by the 2025 Dietary Guidelines Advisory Committee as part of the process to develop the *Dietary Guidelines for Americans, 2025-2030*.

How was this question answered?
The Committee conducted a new systematic review to answer this question with support from the USDA Nutrition Evidence Systematic Review team.

What is the answer to the question?
Infants and Young Children up to age 24 months

- A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months with varying amounts of ultra-processed food and growth, body composition, and risk of obesity because of substantial concerns with consistency and directness in the body of evidence.

Children and Adolescents

- Dietary patterns consumed by children and adolescents with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of overweight. This conclusion statement is based on evidence grade as limited.

Adults and Older Adults

- Dietary patterns consumed by adults and older adults with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of obesity and/or overweight. This conclusion statement is based on evidence grade as limited.

Pregnancy

- A conclusion statement cannot be drawn about the relationship between dietary patterns with varying amounts of ultra-processed food consumed during pregnancy and gestational weight gain because there is not enough evidence available.

Postpartum

- A conclusion statement cannot be drawn about the relationship between dietary patterns with varying amounts of ultra-processed food consumed during postpartum and body composition, and risk of obesity because there is not enough evidence available.

How up-to-date is this systematic review?
Conclusion statement(s) from this review are based on articles published between January 2000 and January 2024

Abstract

Background
This systematic review was conducted by the 2025 Dietary Guidelines Advisory Committee as part of the process to develop the Dietary Guidelines for Americans, 2025-2030. The U.S. Departments of Health and Human Services (HHS) and Agriculture (USDA) appointed the 2025 Dietary Guidelines Advisory Committee (Committee) in January 2023 to review evidence on high priority scientific questions related to diet and health. Their review forms the basis of their independent, science-based advice and recommendations to HHS and USDA, which is considered as the Departments develop the next edition of the Dietary Guidelines. As part of that process, the Committee conducted a systematic review with support from the USDA Nutrition Evidence Systematic Review (NESR) team to answer the following question: What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?

Methods
The Committee conducted a systematic review using the methodology of the USDA NESR team. The Committee first developed a protocol. The intervention/exposure and comparators for all populations were consumption of a dietary pattern with ultra-processed foods (UPF) compared to a dietary pattern without UPF and different adherence to/consumption levels of the same dietary pattern that reflect differences in the amount of UPF. The outcomes were measures of growth, body composition, and risk of obesity in all populations. Additional criteria were established to include: a) randomized or non-randomized controlled trial, prospective or retrospective cohort, or nested case-control designs, b) published in English in peer-reviewed journals, c) studies in countries classified as high or very high level of human development, and d) participants with a range of health statuses. The review excluded studies that exclusively enrolled participants who were being treated for a disease.

NESR librarians performed the literature search in PubMed, Embase, CINAHL, and Cochrane to identify articles published between January 2000 and January 2024. Two NESR analysts independently screened all electronic results and the reference lists of included articles based on the pre-determined criteria. NESR analysts extracted data, from each included article, with a second analyst verifying accuracy of the extraction. Two NESR analysts independently conducted a formal risk of bias assessment, by study design, for each included article, then reconciled any differences in the assessment. The Committee synthesized the eligible evidence from the existing review and the new evidence according to the synthesis plan, with attention given to the overarching themes or key concepts from the findings, similarities and differences between studies, and factors that may have affected the results. The Committee developed conclusion statements and graded the strength of evidence based on its consistency, precision, risk of bias, directness and generalizability.

Results

Infants and Young Children up to Age 24 Months
Conclusion statement[*] and grade: A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months with varying amounts of UPF and growth, body composition, and risk of obesity because of substantial concerns with consistency and directness in the body of evidence. (Grade Not Assignable)
Summary of evidence:
- Five articles from prospective cohort study designs met inclusion for this review in infants and young children.
- The 2025 Committee was not able to draw a conclusion due to critical limitations in the body of evidence.

Children and Adolescents
Conclusion statement and grade: Dietary patterns consumed by children and adolescents with higher amounts of foods classified as UPF are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)
Summary of evidence:
- Twenty-five articles met inclusion for this review in children and adolescents. All 25 articles were prospective cohort studies.
- The direction of results was similar across studies, but effect size differed.
- The size of study groups was small and variance around effect estimates was wide across studies.
- Few studies were designed and conducted well.
- The populations and outcome measures represented those of interest in the review, but most dietary patterns examined did not.
- The evidence applies to the U.S. population, except the types and amounts of UPF examined may not be applicable.

Adults and Older Adults
Conclusion statement and grade: Dietary patterns consumed by adults and older adults with higher amounts of foods classified as UPF are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of obesity and/or overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)
Summary of evidence:

[*] A conclusion statement is carefully constructed, based on the evidence reviewed, to answer the systematic review question. A conclusion statement does not draw implications and should not be interpreted as dietary guidance.

- Sixteen articles met inclusion for this review in adults and older adults. Fifteen articles were prospective cohort study designs and one article was a randomized controlled trial.
- The direction of results was similar across studies, but effect size differed.
- The size of study groups was small and variance around effect estimates was wide across studies.
- Few studies were designed and conducted well.
- The populations and outcome measures represented those of interest in the review, but most dietary patterns examined did not.
- The evidence applies to the U.S. population, except the types and amounts of UPF examined may not be applicable

Pregnancy

Conclusion statements and grades: A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy with varying amounts of UPF and gestational weight gain because there is not enough evidence available. (Grade Not Assignable).

Summary of evidence: One article from a prospective cohort study design met inclusion criteria for this review in individuals during pregnancy. The 2025 Committee was not able to draw a conclusion due to not enough evidence being available.

Postpartum

Conclusion statements and grades: A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during postpartum with varying amounts of UPF and postpartum weight change because there is not enough evidence available. (Grade Not Assignable).

Summary of evidence: Two articles from prospective cohort study designs met inclusion criteria for this review in individuals during postpartum. The 2025 Committee was not able to draw a conclusion due to not enough evidence being available.

Introduction

To prepare for the development of the *Dietary Guidelines for Americans, 2025-2030*, the U.S. Departments of Health and Human Services (HHS) (Appendix 1) and Agriculture (USDA) identified a proposed list of scientific questions based on relevance, importance, potential federal impact, and avoiding duplication, which were posted for public comment.[*] The Departments appointed the 2025 Dietary Guidelines Advisory Committee (Committee) in January 2023 to review evidence on the scientific questions. The Committee's review of the evidence forms the basis of the Scientific Report of the 2025 Dietary Guidelines Advisory Committee[†] which includes independent, science-based advice and recommendations to HHS and USDA and is considered as the Departments develop the next edition of the *Dietary Guidelines*.

The proposed scientific questions were refined and prioritized by the Committee for consideration in their review of the evidence. As part of that process, the following systematic review question was prioritized: What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?

The Committee conducted a systematic review to answer this question, with support from USDA's Nutrition Evidence Systematic Review (NESR) team. This review is new systematic review (**Table 1).**

Table 1. Review history

Date	Description	Citation
May 2023	Systematic review protocol for the 2025 Dietary Guidelines Advisory Committee published online	Hoelscher DM, Anderson CAM, Booth S, Deierlein A, Fung T, Gardner C, Giovannucci E, Raynor H, Stanford FC, Talegawkar S, Taylor C, Tobias D, Obbagy J, English LK, Higgins M, Butera G, Terry N. Dietary Patterns with Ultra-Processed Foods and Growth, Body Composition, and Risk of Obesity: A Systematic Review Protocol. May 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/protocols
October 2023	Systematic review protocol revisions of the 2025 Dietary Guidelines Advisory Committee published online	Hoelscher DM, Anderson CAM, Booth S, Deierlein A, Fung T, Gardner C, Giovannucci E, Raynor H, Stanford FC, Talegawkar S, Taylor C, Tobias D, Obbagy J, English LK, Higgins M, Butera G, Terry N. Dietary Patterns with Ultra-Processed Foods and Growth, Body Composition, and Risk of Obesity: A Systematic Review Protocol. May 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/protocols
February 2024	Systematic review protocol revisions of the 2025 Dietary Guidelines Advisory Committee published online	Hoelscher DM, Anderson CAM, Booth S, Deierlein A, Fung T, Gardner C, Giovannucci E, Raynor H, Stanford FC, Talegawkar S, Taylor C, Tobias D, Obbagy J, English LK, Higgins M, Butera G, Terry N. Dietary Patterns with Ultra-Processed Foods and Growth, Body Composition, and Risk of Obesity: A Systematic Review Protocol. May 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/protocols

[*] Dietary Guidelines for Americans: Learn About the Process. 2022. Available at: https://www.dietaryguidelines.gov/work-under-way/learn-about-process

[†] 2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

Methods

The Committee used NESR's methodology to conduct this systematic review. NESR's methodology is described in detail in its methodology manual,* as well as in the Committee's scientific report†. This section presents an overview of the specific methods used to answer the systematic review question: What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?

Develop a protocol

A systematic review protocol is the plan for how NESR's methodology is used to conduct a specific systematic review and is established by the Committee, *a priori*, before any evidence is reviewed. The protocol is designed to capture the most appropriate and relevant body of evidence to answer the systematic review question. Development of the protocol involves discussion of the strengths and limitations of various methodological approaches relevant to the question, which then inform subsequent steps of the systematic review process. The protocol describes all of the methods used throughout the systematic review process. Additionally, the protocol includes the following components, which are tailored to each systematic review question: the analytic framework, the inclusion and exclusion criteria, and the synthesis plan.

The protocol was posted online (https://nesr.usda.gov/protocols) for the public to view and comment on. Revisions to the systematic review protocol were made during the review process. These amendments are documented in **Table 2**.

Table 2. Protocol revisions

Date	Protocol revision	Description
July 2023	Inclusion and exclusion criteria were added for confounders, specifying that studies must control for at least one key confounder listed in the analytic framework to be included.	This revision was made to enable focus on a stronger body of evidence. The revision was made before any evidence was synthesized.
July 2023	The inclusion and exclusion criteria for the outcome of gestational weight gain were revised to include only those studies that examine adequacy of total gestational weight gain (i.e., in relation to recommendations based on pre-pregnancy BMI). Studies that examine gestational weight gain during certain time periods or trimesters of pregnancy or total gestational weight gain not in relation to recommendations will be excluded.	This revision was made to focus on the most clinically meaningful measure of gestational weight gain. The revision was made before any evidence was synthesized.

* USDA Nutrition Evidence Systematic Review Branch. USDA Nutrition Evidence Systematic Review: Methodology Manual. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview

† 2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

Date	Protocol revision	Description
July 2023	The inclusion and exclusion criteria for the intervention/exposure and comparator were revised to clarify that: • a study must provide a description of the foods and beverages in both the intervention/exposure and comparator groups to be included. • studies that examine consumption of and/or adherence to similar dietary patterns of which only a specific component or food source differs between groups are excluded.	These revisions were made before evidence synthesis to clarify the intent of the intervention/exposure and comparator criteria, but do not represent a change in how the criteria were applied.
September 2023	The inclusion criteria for study duration for weight loss and weight loss maintenance was reduced from ≥6 months and 12 months, respectively, to ≥12 weeks.	This revision was made so that study duration criteria is consistent across all growth, body composition, and risk of obesity outcomes. Longer-term studies on weight loss and weight loss maintenance will be prioritized in evidence synthesis. The revision was made before any evidence was synthesized.
September 2023	The exclusion criteria for outcome were revised to specify that studies that only report unintentional weight loss (i.e., a component of frailty) will be excluded.	This revision was made to clarify the intent of the outcome criteria but does not represent a change in how the criteria were applied.
January 2024	The inclusion and exclusion criteria for the intervention/exposure and comparator were revised to clarify the comparisons of interest are: • Consumption of a dietary pattern with ultra-processed foods (UPF) compared to a dietary pattern without UPF • Different adherence to/consumption levels of the same dietary pattern that reflect differences in the amount of UPF	This revision was made to better determine the effect of different amounts of UPF in dietary patterns on outcomes. This revision was made before any evidence was synthesized for this question.
January 2024	The inclusion and exclusion criteria for the publication date were revised to correct the search date range of literature is January 2000 to January 2024.	This revision was to update an error in the original protocol.

Develop an analytic framework

An analytic framework visually represents the overall scope of the systematic review question and depicts the contributing elements that were examined and evaluated. It presents the core (**PICO**) elements of each systematic review question, including the **P**opulation (i.e., those who experience the intervention/exposure and/or outcome), **I**ntervention and/or exposure (i.e., the independent variable of interest), **C**omparator (i.e., the alternative being compared to the intervention or exposure), and **O**utcome(s). Definitions for key terms are also included because they provide the basis for how concepts are operationalized throughout the review. The Committee identified key confounders based on their knowledge of nutrition and health research and experience as subject matter experts. Key confounders are factors related to both intervention/exposure and the outcome of interest that may impact the estimated effects of interest, such as demographics, health status, and diet and lifestyle behaviors, and/or other factors related to both the intervention/exposure and the outcome of interest that may impact the relationships of interest. Key confounders were considered during review and evaluation of the evidence, particularly during the risk of bias assessment of non-randomized and observational studies.

Figure 1 is the analytic framework for the systematic review and shows that the interventions or exposures and comparators of interest are a) dietary patterns with ultra-processed foods (UPF) compared to dietary patterns without UPF, and b) different levels of adherence to/consumption of the same dietary pattern that reflect differences in the amounts of UPF, consumed by infants, young children up to age 24 months, children, adolescents, adults, older adults, individuals during pregnancy, and individuals during postpartum. The outcomes are growth (in infants, young children up to age 24 months, children, adolescents) including: height, length/stature-for-age, weight, weight-for-age, stunting, failure to thrive, wasting, BMI-for-age, weight-for-length/stature, body circumferences (arm, neck, thigh), head circumference; Body composition (in infants, young children up to age 24 months, children, adolescents, adults, older adults) including: skinfold thickness, fat mass, ectopic fat, fat-free mass or lean mass, waist circumference, waist-to-hip-ratio; Risk of obesity (in children, adolescents, adults, older adults) including: BMI, underweight, normal weight, overweight and/or obesity, weight loss and maintenance (in adults, older adults); Pregnancy and postpartum-related weight change (in individuals during pregnancy or postpartum) including: gestational weight gain and postpartum weight change. The key confounders may impact the relationships of interest and are sex, age, physical activity, anthropometry at baseline, socioeconomic position, race and/or ethnicity in all populations, alcohol intake in adults and older adults, smoking in adults, older adults, during pregnancy and postpartum, parity (pregnancy, postpartum), diabetes mellitus in the current pregnancy (pregnancy), hypertensive disorders in the current pregnancy (pregnancy), and human milk feeding status (postpartum). Dietary patterns are defined as the quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

Figure 1. Analytic framework for the systematic review question: What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?

<table>
<tr><th>Population</th><th>Intervention/ exposure and Comparator</th><th>Outcome</th><th>Key confounders</th></tr>
<tr><td>Infants and young children up to age 24 months</td><td rowspan="3">• Consumption of a dietary pattern with ultra-processed foods (UPF) compared to a dietary pattern without UPF

• Different adherence to/consumption levels of the same dietary pattern that reflect differences in the amount of UPF</td><td rowspan="3">Growth (in infants, young children up to age 24 months, children, adolescents)
• Height, length/stature-for-age
• Weight, weight-for-age
• Stunting, failure to thrive, wasting
• BMI-for-age, weight-for-length/stature
• Body circumferences (arm, neck, thigh)
• Head circumference
Body composition (in infants, young children up to age 24 months, children, adolescents, adults, older adults)
• Skinfold thickness
• Fat mass, ectopic fat
• Fat-free mass or lean mass
• Waist circumference, waist-to-hip-ratio
Risk of obesity (in children, adolescents, adults, older adults)
• BMI
• Underweight
• Normal weight
• Overweight and/or obesity
• Weight gain
• Weight loss and maintenance (adults, older adults)</td><td rowspan="3">• Sex
• Age
• Physical activity
• Race and/or ethnicity
• Socioeconomic position
• Anthropometry at baseline
• Smoking (adults, older adults)
• Alcohol intake (adults, older adults)</td></tr>
<tr><td>Children and adolescents
(2 up to 19 years)</td></tr>
<tr><td>Adults and older adults (19 years and older)</td></tr>
<tr><td>Individuals during pregnancy and postpartum</td><td>• Consumption of a dietary pattern with UPF compared to a dietary pattern without UPF

• Different adherence to/consumption levels of the same dietary pattern that reflect differences in the amount of UPF</td><td>Pregnancy and postpartum-related weight change (in individuals during pregnancy or postpartum)
• Gestational weight gain
• Postpartum weight change</td><td>• Age
• Physical activity
• Race and/or ethnicity
• Socioeconomic position
• Anthropometry at baseline
• Smoking
• Parity
• Diabetes mellitus in the current pregnancy (pregnancy)
• Hypertensive disorders in the current pregnancy (pregnancy)
• Human milk feeding status (postpartum)</td></tr>
</table>

Synthesis organization:

I. ***Population***: Infants and young children up to age 24 months; Children and adolescents; Adults; Older adults; Individuals during pregnancy; Individuals during postpartum
   i. ***Outcome:*** Growth; Body composition; Risk of obesity; Weight loss and maintenance; Pregnancy and postpartum-related weight change

Key definitions: Dietary patterns: the quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

Develop inclusion and exclusion criteria

The inclusion and exclusion criteria provide an objective, consistent, and transparent framework for determining which articles to include in the systematic review (**Table 3**). These criteria ensure that the most relevant and appropriate body of evidence is identified for the systematic review question, and that the evidence reviewed is[*]:

- Applicable to the U.S. population of interest
- Relevant to Federal public health nutrition policies and programs
- Rigorous from a scientific perspective

Table 3. Inclusion and exclusion criteria

Category	Inclusion Criteria	Exclusion Criteria
Study design	• Randomized controlled trials • Non-randomized controlled trials[†] • Prospective cohort studies • Retrospective cohort studies • Nested case-control studies	• Uncontrolled trials[‡] • Case-control studies • Cross-sectional studies • Ecological studies • Narrative reviews • Systematic reviews • Meta-analyses • Modeling and simulation studies
Publication date	• January 2000 – January 2024	• Before January 2000, after January 2024
Population: Study participants	• Human	• Non-human
Population: Life stage	At intervention or exposure and outcome: • Infants and young children up to age 24 months • Children and adolescents (2 up to 19 years) • Adults and older adults (19 years and older) • Individuals during pregnancy • Individuals during postpartum	At intervention or exposure and outcome: • Individuals before pregnancy

[*]USDA Nutrition Evidence Systematic Review Branch. USDA Nutrition Evidence Systematic Review: Methodology Manual. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview

[†] Including quasi-experimental and controlled before-and-after studies

[‡] Including uncontrolled before-and-after studies

Category	Inclusion Criteria	Exclusion Criteria

Population: Health status	• Studies that exclusively enroll participants not diagnosed with a disease[*]
	• Studies that enroll some participants:
	  ○ diagnosed with a disease;
	  ○ with severe undernutrition, failure to thrive/underweight, stunting, or wasting;
	  ○ born preterm,[†] with low birth weight,[‡] and/or small for gestational age;
	  ○ and/or with the outcome of interest
	  ○ who became pregnant using Assisted Reproductive Technologies;
	  ○ with multiple gestation pregnancies;
	  ○ pre- or post-bariatric surgery;
	  ○ and/or receiving pharmacotherapy to treat obesity
		• Studies that exclusively enroll participants:
		  ○ diagnosed with a disease;[§]
		  ○ hospitalized for an illness, injury, or surgery;[**]
		  ○ with severe undernutrition, failure to thrive/underweight, stunting, or wasting;
		  ○ born preterm,[†] with low birth weight,[‡] and/or small for gestational age
		  ○ who became pregnant using Assisted Reproductive Technologies;
		  ○ with multiple gestation pregnancies;
		  ○ pre- or post-bariatric surgery;
		  ○ and/or receiving pharmacotherapy to treat obesity

Intervention/ exposure	• Studies that examine consumption of and/or adherence to a dietary pattern [i.e., the quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed] with varying amounts of ultra-processed foods (UPF), including, at a minimum, a description of the foods and beverages in the pattern of each intervention/exposure and comparator group ○ Dietary patterns may be measured or derived using a variety of approaches, such as adherence to a priori patterns (indices/scores), data driven patterns (factor or cluster analysis), reduced rank regression, or other methods, including clinical trials • Multi-component intervention in which the isolated effect of the dietary pattern with varying amounts of ultra-processed foods on the outcome(s) of interest is provided or can be determined	• Studies that do not provide a description of the dietary pattern, which at minimum, must include the foods and beverages in the pattern (i.e., studies that examine a labeled dietary pattern, but do not describe the foods and beverages consumed in each intervention/exposure and comparator group) • Studies that examine consumption of and/or adherence to a dietary pattern(s) of which the amount of or definition of UPF cannot be determined. • Multi-component intervention in which the isolated effect of the intervention of interest on the outcome(s) of interest is not provided or cannot be determined (e.g., due to multiple intervention components within groups)

[*] Studies that enroll participants who are at risk for chronic disease were included

[†] Gestational age <37 weeks and 0/7 days

[‡] Birth weight <2500g

[§] Studies that exclusively enroll participants with obesity were included

[**] Studies that exclusively enroll participants post-cesarean section were included

Category	Inclusion Criteria	Exclusion Criteria
Comparator	• Studies that compare a dietary pattern with UPF compared to a dietary pattern without UPF • Different levels of consumption of and/or adherence to the same dietary pattern that reflect differences in the amount of UPF	• Consumption of and/or adherence to a similar dietary pattern of which only a specific component or food source differs between groups and/or the different amounts of or definition of UPF cannot be determined,
Outcome(s)	• Growth (in infants, young children up to age 24 months, children, adolescents) o Height, length/stature-for-age o Weight, weight-for-age o Stunting, failure to thrive, wasting o BMI-for-age, weight-for-length/stature o Body circumferences (arm, neck, thigh) o Head circumference • Body composition (in infants, young children up to age 24 months, children, adolescents, adults, older adults) o Skinfold thickness o Fat mass, ectopic fat o Fat-free mass or lean mass o Waist circumference, waist-to-hip-ratio • Risk of obesity (in children, adolescents, adults, older adults) o BMI o Underweight o Normal weight o Overweight and/or obesity o Weight gain o Weight loss and maintenance (in adults, older adults) • Pregnancy and postpartum-related weight change (in individuals during pregnancy or postpartum) o Adequacy of total gestational weight gain (i.e., in relation to	• Gestational weight gain only during certain time periods or trimesters of pregnancy • Absolute total gestational weight gain (i.e., not in relation to recommendations based on pre-pregnancy BMI) • Weight loss that is specifically classified as unintentional weight loss (e.g., a component of frailty)

Category	Inclusion Criteria	Exclusion Criteria
	recommendations based on pre-pregnancy BMI) ○ Postpartum weight change	
Confounders	• Studies that control for at least one of the key confounders listed in the analytic framework	• Studies that do not control for any of the key confounders listed in the analytic framework
Study duration (not applied to pregnancy and postpartum studies)	• Intervention length ≥12 weeks	• Intervention length <12 weeks
Size of study groups (not applied to pregnancy and postpartum studies)	• For intervention studies: ○ ≥30 participants per study group for between-subject analyses, ○ or a power calculation indicating that the study is appropriately powered for the outcome(s) of interest • For observational studies: ○ Analytic sample size of ≥1000 participants (only for adults and older adults)	• For intervention studies: ○ <30 participants per study group for between-subject analyses, ○ and no power calculation indicating that the study is appropriately powered for the outcome(s) of interest • For observational studies: ○ Analytic sample size n<1000 (only for adults and older adults)
Publication status	• Peer-reviewed articles published in research journals	• Non-peer reviewed articles, unpublished data or manuscripts, pre-prints, reports, and conference abstracts or proceedings
Language	• Published in English	• Not published in English
Country[*]	• Studies conducted in countries classified as high or very high on the Human Development Index the year(s) the intervention/exposure data were collected	• Studies conducted in countries classified as medium or low on the Human Development Index the year(s) the intervention/exposure data were collected

[*] The classification of countries on the Human Development Index (HDI) is based on the UN Development Program Human Development Report Office (http://hdr.undp.org/en/data) for the year the study intervention occurred or data were collected. Studies conducted prior to 1990 are classified based on 1990 HDI classifications. If the year is more recent than the available HDI values, then the most recent HDI classifications are used. If a country is not listed in the HDI, then the current country classification from the World Bank is used (The World Bank. World Bank country and lending groups. Available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world- country-and-lending-groups)

Search for and screen studies

NESR librarians, in collaboration with NESR analysts and the Committee, used the analytic framework and inclusion and exclusion criteria to develop a comprehensive literature search strategy. The literature search strategy included selecting and searching the appropriate bibliographic databases, translating search terms using syntax appropriate for the databases being searched, and employing search refinements, such as search filters. The full literature search strategy is documented in **Appendix 3**.

The results of all electronic database searches, after removal of duplicates, were screened independently by two NESR analysts using a stepwise process of reviewing titles, abstracts, and full texts to identify articles meeting the inclusion criteria. Manual searching was conducted to find peer-reviewed published articles not identified through the electronic database search. These articles were also screened independently by two NESR analysts at the abstract and full-text levels.

Extract data and assess the risk of bias

NESR analysts extracted all essential data from each included article to describe key characteristics of the available evidence, such as the author, publication year, cohort/trial name, study design, population life stage at intervention/exposure and outcome, intervention/exposure and outcome assessment methods, and outcomes. One NESR analyst extracted the data and a second NESR analyst reviewed the extracted data for accuracy. Each article included in the systematic review underwent a formal risk of bias assessment, with two NESR analysts independently completing the risk of bias assessment using the tool that is appropriate for the study design.[*†‡§]

Synthesize the evidence

The Committee described, compared, and combined the evidence from all included studies to answer the systematic review question. Synthesis of the body of evidence involved identifying overarching themes or key concepts from the findings, identifying and explaining similarities and differences between studies, and determining whether certain factors impact the relationships being examined, which includes potential causes of heterogeneity across all included evidence.

Extracted data and risk of bias assessments for all included studies were tabulated to visually display results and facilitate synthesis. During synthesis, the Committee considered the effect direction, magnitude, and statistical significance of the results reported across the articles included in the body of evidence. The evidence was synthesized qualitatively without meta-analysis of effect estimates, statistical pooling or conversion of data, or quantitative tests of heterogeneity.

The synthesis plan for this review was designed with the end-use in mind, to inform the Committee's advice to HHS and USDA regarding dietary guidance across life stages. The first level of synthesis organization was by population at intervention or exposure. Then, the evidence was considered based on similar outcomes across the available evidence.

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[*] Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*. 2019; **366**: l4898.doi:10.1136/bmj.l4898

[†] Sterne JAC, Hernán MA, Reeves BC et al. ROBINS-I: a tool for assessing risk of bias in non-randomized studies of interventions. *BMJ*. 2016; 355; i4919; doi: 10.1136/bmj.i4919

[‡] Higgins JPT, Morgan RL, Rooney AA, et al. A tool to assess risk of bias in non-randomized follow-up studies of exposure effects (ROBINS-E). Environment International 2024 (published online Mar 24); doi: 10.1016/j.envint.2024.108602.

Develop a conclusion statement and grade the evidence

After the Committee synthesized the body of evidence, they drafted a conclusion statement. A conclusion statement is one or more summary statements carefully constructed to answer the systematic review question. Each conclusion statement reflects the evidence reviewed, as outlined in the analytic framework (e.g., PICO elements) and synthesis plan, and does not take evidence from other sources into consideration. Conclusion statements do not draw implications and should not be interpreted as dietary guidance. The Committee reviewed, discussed, and revised the conclusion statement until they reached consensus on wording that accurately reflected the body of evidence.

The Committee then graded the strength of the evidence underlying each conclusion statement using NESR's predefined criteria for five grading elements: consistency, precision, risk of bias, directness and generalizability of the evidence. Study design and publication bias were also considered.[*]

- Consistency: Consistency considers the degree of similarity in the direction and magnitude of effect across the body of evidence. This element also considers whether differences across the results can be explained by variations in study designs and methods.
- Precision: Precision considers the degree of certainty around an effect estimate for a given outcome. This element considers measures of variability, such as the width and range of confidence intervals, the number of studies, and sample sizes, within and across studies.
- Risk of bias: Risk of bias considers the likelihood that systematic errors resulting from the design and conduct of the studies could have impacted the accuracy of the reported results across the body of evidence.
- Directness: Directness considers the extent to which studies are designed to directly examine the relationship among the interventions/exposures, comparators, and outcome(s) of primary interest in the systematic review question.
- Generalizability: Generalizability considers whether the study participants, interventions and/or exposures, comparators, and outcomes examined in the body of evidence are applicable to the U.S. population of interest for the review.

The Committee assigned an overall grade to each conclusion statement from the following options: strong, moderate, limited, or grade not assignable. The grade communicates the strength of the evidence supporting a specific conclusion statement to decision makers and stakeholders. A conclusion statement can receive a grade of Strong, Moderate, or Limited, and if insufficient or no evidence is available to answer a systematic review question, then no grade is assigned (i.e., Grade Not Assignable) (**Table 4**). The overall grade is not based on a predefined formula for scoring or tallying ratings of each element. Rather, each overall grade reflects the expert group's thorough consideration of all of the grading elements, as they each relate to the specific nuances of the body of evidence under review.

[*] Spill MK, English LK, Raghavan R, et al. Perspective: USDA Nutrition Evidence Systematic Review Methodology: Grading the Strength of Evidence in Nutrition- and Public Health-Related Systematic Reviews. Adv Nutr. 2022 Aug 1;13(4):982-991. doi: 10.1093/advances/nmab147

Table 4. Definitions of NESR grades

Grade	Definition
Strong	The conclusion statement is based on a strong body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is strong, such that if new evidence emerges, modifications to the conclusion are unlikely to be required.
Moderate	The conclusion statement is based on a moderate body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is moderate, such that if new evidence emerges, modifications to the conclusion may be required.
Limited	The conclusion statement is based on a limited body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is limited, such that if new evidence emerges, modifications to the conclusion are likely to be required.
Grade Not Assignable	A conclusion statement cannot be drawn due to either a lack of evidence, or evidence that has severe limitations related to consistency, precision, risk of bias, directness, and generalizability.

Recommend future research

The Committee identified and documented research gaps and methodological limitations throughout the systematic review process. These gaps and limitations are used to develop research recommendations that describe the research, data, and methodological advances that are needed to strengthen the body of evidence on a particular topic. Rationales for the necessity of additional or stronger research are provided with the research recommendations.

Peer review

This systematic review underwent external peer review in a process coordinated by staff from the National Institutes of Health (NIH). NIH staff identified potential peer reviewers through outreach to a variety of professional organizations to select academic reviewers from U.S. colleges and universities across the country with a doctorate degree, including MDs, and expertise specific to the questions being reviewed. All peer reviewers were external to the *Dietary Guidelines* process, and therefore, current Committee members or Federal staff who supported the Committee or the development of the *Dietary Guidelines* were not eligible to serve as peer reviewers.

The peer review process was anonymous and confidential in that the peer reviewers were not identified to the Committee members or NESR staff, and in turn, the reviewers were asked not to share or discuss the review with anyone. Peer reviewers were made aware that per USDA, FNS agency policy, all peer reviewer comments would be summarized and made public, but comments would not be attributed to a specific reviewer.

Peer review occurred after draft conclusion statements were discussed by the full Committee at its third, fourth, fifth, and sixth public meetings. NIH staff assigned and distributed the reviews to at least 2 peer reviewers based on area of expertise. Following peer review, the Committee reviewed and discussed comments and made revisions to the systematic review, as needed, based on the discussion.

Health equity considerations

The Committee was charged by HHS and USDA to review all scientific questions with a health equity lens to ensure that the next edition of the Dietary Guidelines is relevant to people with diverse racial, ethnic, socioeconomic, and cultural backgrounds. The Committee made a number of health equity considerations throughout the NESR systematic review process. The Committee's Scientific Report* includes a more detailed discussion of their approach to applying a health equity lens to their review of evidence, but examples of how the Committee incorporated health equity considerations into its systematic reviews and evidence scan include consideration of key confounders relevant to health equity and assessment of generalizability of the evidence.

Results

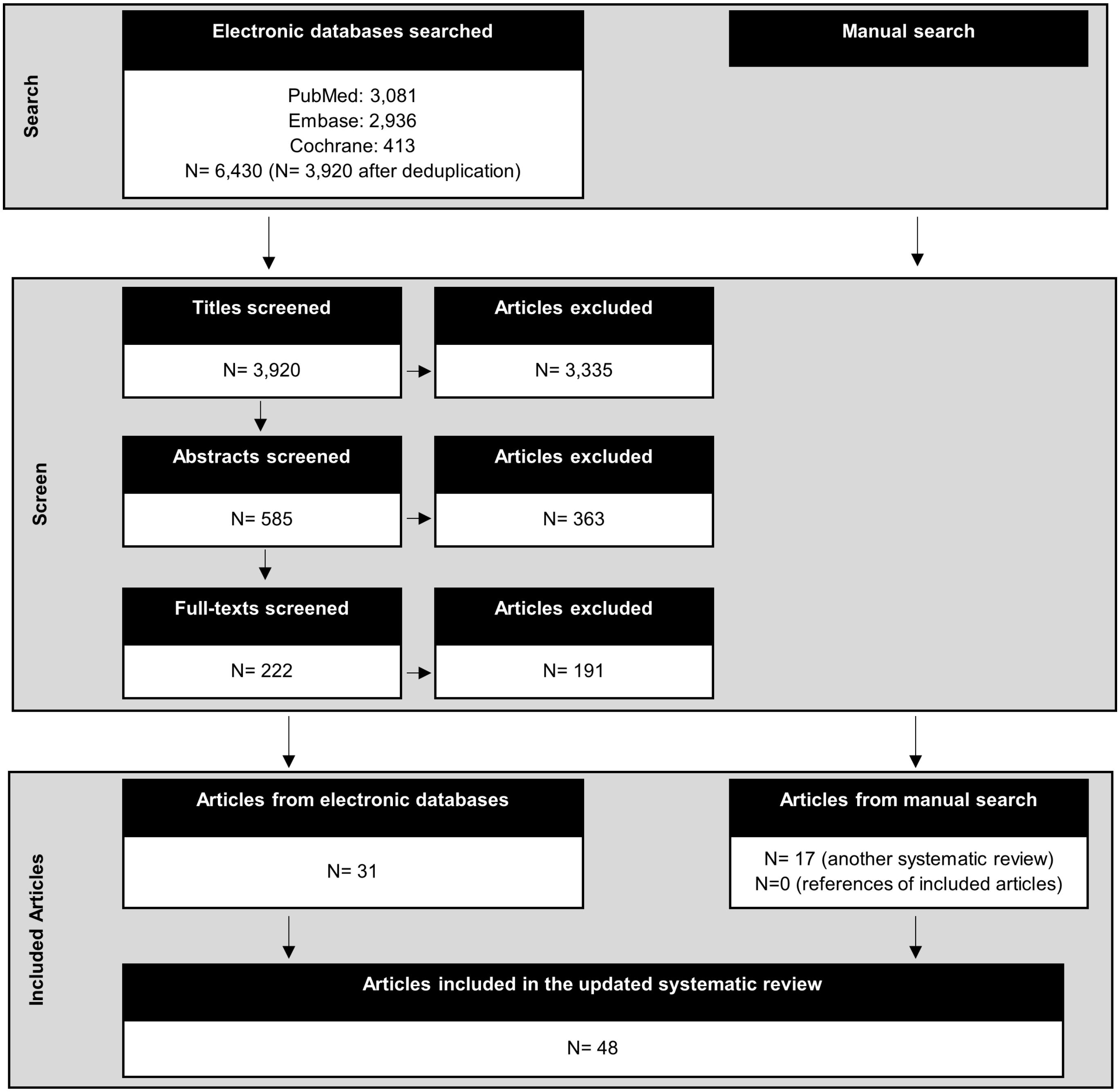
Literature search and screening results

The articles included in this systematic review were identified from two literature searches (**Appendix 2**). The primary literature search was conducted to identify articles examining dietary patterns with UPF and growth, body composition, and risk of obesity. That literature search yielded 3920 search results after the removal of duplicates (see **Figure 2**). Dual-screening resulted in the exclusion of 3335 titles, 363 abstracts, and 191 full-texts articles from that search. The results of a second literature search that was conducted for another systematic review† on dietary patterns and growth, body composition, and risk of obesity was manually searched. NESR analysts identified 17 articles from that literature search that examined dietary patterns with varying amounts of UPF. Reasons for full-text exclusion are in **Appendix 3**. The body of evidence included 48 articles in infants and young children up to age 24 months, n=5[1-5]; children and adolescents, n=25[6-30]; adults and older adults, n=16[31-46]; and individuals during pregnancy and/or postpartum, n=2 [47,48]

*2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

† Hoelscher DM, Anderson, Booth, et al. Dietary Patterns and Growth, Body Composition, and Risk of Obesity: A Systematic Review. Date TBD. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/

Figure 2. Literature search and screening flow chart.



Infants and young children up to age 24 months

Five articles met inclusion criteria that examined the relationship between dietary patterns with varying amounts of UPF consumed by infants and young children up to age 24 months and growth, body composition, and risk of obesity (also see **Table 2**). All 5 articles reported data from prospective cohort study designs.[1-5]

Description of the evidence

Population

Sample size of studies ranged from 449 to 14,989 participants, conducted in 4 countries (United Kingdom (n=2), Norway (n=1), Scotland (n=1), and United States (n=1)). Two articles from the Southampton Women's Survey cohort were included but examined dietary patterns (exposure) and outcomes at different ages. Other cohorts represented in the included articles were: Norwegian Mother, Father and Child Cohort Study; Nurture Observational Study; and Growing Up in Scotland (GUS) Study.

Studies examined dietary patterns consumed at ages ranging from 4 months up to 2 years, with most examining 6 to 12 months. Three of the articles reported some information on the racial or ethnic background of participants as follows: 1) 4% non-white; 2) 65.2% non-Hispanic Black; 3) 94% White. One study, conducted in the United States, enrolled majority (~59%) low-income participants. Socioeconomic position (SEP) was reported in 4 of the 5 articles, with maternal education being the most used proxy.

Intervention/exposure and comparator

All studies used food-frequency questionnaires to assess habitual consumption of individual foods and/or food groups, administered by researchers or self-administered by caregivers. All but one study collected diet at more than one time point, which had a single assessment at age 19-24 months. Approaches used to examine dietary patterns were factor/cluster analyses (n=3) or index/score analyses (n=2).

Outcomes

Weight, height, and/or body composition of participants was measured in-person using standard protocols, instruments and trained staff in all but one article, which collected information via parent-report.[2] Cut points and measures used to categorize or classify participants' outcome status were: BMI percentile, BMI z-score, or other ratios of weight-to-height (e.g., BMI reference curves vs. WHO vs. Cole's method[*]). The following outcomes were reported across the body of evidence:

- BMI, BMI z-score, or weight-for-length z-score[1,4,5]
- Adiposity (e.g. fat mass),[3,4]
- Risk of overweight and/or obesity,[1,2]
- Weight/weight gain,[1-5]
- Length/length gain[3]

Synthesis of the evidence

None of the studies and/or dietary patterns were designed specifically to examine varying amounts of UPF within dietary patterns and their association with the outcomes of interest. The mean intakes of UPF in the study populations were not reported.

[*] Cole, T.J., Bellizzi, M.C., Flegal, K.M., Dietz, W.H. Establishing a standard definition for child overweight and obesity worldwide: International survey. British Medical Journal 2000;320(7244):1240-1243.

Across all studies, the results varied for both the direction and magnitude of effect estimates from analyses comparing participants consuming dietary patterns that reflected higher compared to lower amounts of foods that are typically classified as UPF.[1-5] Two articles reported no associations between dietary patterns varying in UPF and risk of overweight or obesity.[1,2]Three studies reported no association with dietary patterns varying in UPF and BMI z-score, weight-for-length z-score, and/or BMI.[1,2,3,4] One study observed that a dietary pattern with fewer UPF was associated with lower weight-for-length z-score, but other dietary patterns were not associated with weight-for-length z-score when compared to the dietary pattern with the most UPF.[5] One study observed a positive association between dietary patterns higher in UPF and weight gain between 6-12 months of age, but not weight through follow-up at age 12 months.[3]

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee did not develop a conclusion statement to answer the question because of substantial concerns with consistency and directness in the available evidence (Table 5). Studies also had numerous concerns due to risk of bias (Table 7). This body of evidence includes both large and small studies, including studies with smaller sample sizes and null findings, which makes publication bias less likely.

Table 5. Conclusion statement, grades for dietary patterns with varying amounts of ultra-processed food consumed by infants and young children, up to age 24 months, and growth, body composition, and risk of obesity.

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months with varying amounts of ultra-processed food and growth, body composition, and risk of obesity because of substantial concerns with consistency and directness in the body of evidence.**
Grade	Grade not assignable
Body of Evidence	5 articles from prospective cohort studies
Rationale	Critical limitations in the consistency across the body of evidence for the timing of exposure and outcome assessments, reporting of outcomes, and direction and magnitude of effect estimates. Dietary assessment methods and the derived dietary patterns were not designed to quantify UPF intake, which substantially limited the ability to adequately assess the evidence, particularly for directness.

Table 6. Studies examining the relationship between dietary patterns with varying amounts of ultra-processed food consumed by infants and young children up to age 24 months and growth, body composition and composition and risk of obesity[a]

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Abraham, 2012 [1] Scotland; Growing Up in Scotland (GUS) study (2005-2008) Analytic N=4493 **Participant characteristics:** NR; 4% non-white ethnic group (Bradshaw, 2007); NR Variables with >5% missing responses excluded from cluster analysis. Excluded infants with missing data points for models in Tables 2 and 3.	**Age at Dietary Pattern**: 19 to 24 months Cluster 1 (Negative): low fruit, vegetable; high sweets, crisps, soft drinks, snacking Cluster 2 (Positive): high fruit, vegetable; low snacking **Method(s)**: Factor/Cluster	**Age at Follow-up: 4 years** Frequency of Overweight/Obesity at 45-48 months: 12.5% vs. 11.9%, P=0.598, NS Cluster 1 v. Cluster 2, ref & BMI z-score: 0.96, 95% CI: 0.76, 1.21	• Diet assessed via FFQ • Cannot determine whether groups were similar at baseline on key characteristics • Bradshaw, 2007 summarizes Sweep 1 baseline characteristics **Funding**: Growing Up in Scotland (GUS) data set received no specific grant from any funding agency in the public, commercial or not-for profit sector.
Agnihotri, 2021 [2] Norway; Norwegian Mother, Father and Child Cohort Study (MoBa) Analytic N=14989 **Participant characteristics:** 49.7% female; NR; 30% ≤ 12y maternal education Enrolled mothers during pregnancy; Excluded if missing data from Medical Birth Registry of Norway; missing questionnaire data during pregnancy; multiple pregnancies; additional pregnancies by same mother; extreme intake during pregnancy; child age <7 or >9.5 years at outcome; missing outcome data; anthropometric data outside +/- 4 SD	**Age at Dietary Pattern:** 6 months, 18 months New Nordic Diet (NND) score, 6 months: Positive: homemade Fruit puree (v. commercial); homemade Dinners (v. commercial); homemade Porridge (v. commercial); Exclusive breast-fed ≥4 months; Any breast-fed at 6 months; Water (v. sweetened beverages) **Method(s)**:Index or Score Analysis	**Age at Follow-up: 8 years** NND at 6 months & Risk of Overweight • Low, OR: 1.00, ref • Medium, OR: 1.05, 95% CI: 0.93, 1.16; p-trend=0.402 • High, OR: 0.97, 95% CI: 0.83, 1.13; p-trend=0.724 • Per 1-pt, OR: 0.99, 95% CI: 0.96, 1.03; p-trend=0.773	• Diet assessed at two times using FFQ via maternal-report, but FFQ and components varied • Overweight assessed from BMI computed from parent-reported child height & weight at 8 years **Funding**: Norwegian Ministry of Health and Care Services, Ministry of Education and Research

Article Information	Intervention/exposure and comparator	Results	Methodological considerations

Baird, 2008 [3]
United Kingdom; Southampton Women's Survey (SWS)
 	
Analytic N=1740
 	
Participant characteristics: 46.9% female; 94% white; Maternal educational attainment:
• None, 2%;
• GCSE D-G, 10%;
• GCSE A-C, 28%;
• A levels, 30%;
• HND, 8%;
• Degree, 22%
 	
Excluded multiples and preterm births
	Age at Dietary Pattern: 6 months
	
	'Infant Guidelines': high frequency of consumption of vegetables, fruit, meat, fish, home-prepared foods, breast milk; low frequency of consumption of commercial baby foods in jars and formula
	
	'Adult Foods': high frequency of consumption of bread, savory snacks, biscuits, squash, breakfast cereals, and crisps; low frequency of breast milk, baby rice, and cooked and canned fruit
	
	Method(s): Factor/Cluster
		Age at Follow-up: 12 months
		
		'Infant Guidelines'
		• Skinfold thickness
		  ○ 6-12 months, β: 0.11, 95% CI: 0.04, 0.18; P-value: 0.002
		  ○ at 12 months, β: 0.13, 95% CI: 0.01, 0.25; p=0.03
		• Weight
		  ○ 6-12 months, β: 0.10, 95%CI: 0.04, 0.17; p=0.002
		  ○ at 12 months, β: 0.07, 95% CI: -0.01, 0.14; p=0.09
		• Length
		  ○ 6-12 months, β: 0.03, 95%CI: -0.04, 0.10; p=0.225
		  ○ at 12 months; β: 0.04, 95% CI: -0.13, 0.21; p=0.612
		
		'Adult foods'
		• Skinfold thickness
		  ○ 6-12 months: β: 0.00, 95% CI: -0.07, 0.07; p= 0.92
		  ○ at 12 months: β: 0.01, 95% CI: -0.12, 0.13; p=0.89
		• Weight
		  ○ 6-12 months, β:-0.08, 95%CI: -0.15, -0.02; p=0.0015
		  ○ at 12 months, β: 0.02, 95% CI: -0.06, 0.10; P=0.60
		• Length
		  ○ 6-12 months, β:-0.04, 95%CI: -0.11, 0.03; p=0.225
		  ○ at 12 months; β: 0.00, 95% CI: -0.17, 0.17; p=0.984
			• Diet assessed with repeat measures using FFQ via maternal-report
			• Weight, length, body composition measured
			• Cannot determine whether groups were similar at baseline
			• Unclear whether outcome assessors were blinded to the infants' feeding histories
			• Ethnic minorities were underrepresented in this sample.
			• **Funding**: UK Medical Research Council; University of Southampton British Heart Foundation Food Standards Agency Dunhill Medical Trust

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Robinson, 2009 [4] United Kingdom; Southampton Women's Survey Analytic N=536 **Participant characteristics:** 47% Female; Race/ethnicity NR; Maternal educational attainment: lower than A-levels, ~38-49%; A-levels or higher, ~62-51% Singletons, who were followed-up from birth until age 4 years.	**Age at Dietary Pattern:** 12 months 'Infant guidelines pattern': High consumption of fruit, vegetables, cooked meat and fish, and other home-prepared foods (rice, pasta), and low consumption of commercial baby foods **Method(s)**: Factor/Cluster	**Age at Follow-up: 4 years** mean lean mass (kg) • < -0.68: 12.0, 95% CI: 11.7, 12.4 • -0.68 to 0: 12.3, 95% CI: 12.1, 12.6 • 0 to 0.68: 12.7, 95% CI: 12.4, 12.9 • ≥0.68: 12.6, 95% CI: 12.3, 12.9; P-trend: 0.003 mean lean mass index (kg/m^2) • <-0.68: 11.7, 95% CI: 11.5, 11.9 • -0.68 to 0: 11.8, 95% CI: 11.6, 11.9 • 0 to 0.68: 11.9, 95% CI: 11.8, 12.0 • ≥0.68: 11.9, 95% CI: 11.8, 12.1; P-trend: 0.004 mean fat mass (kg) • <-0.68: 4.5, 95% CI: 4.3, 4.7 • -0.68 to 0: 4.7, 95% CI: 4.5, 4.9 • 0 to 0.68: 4.7, 95% CI: 4.5, 4.9 • ≥0.68: 4.5, 95% CI: 4.3, 4.6 P-trend: 0.781 mean fat mass index (kg) • <-0.68: 4.3, 95% CI: 4.1, 4.4 • -0.68 to 0: 4.3, 95% CI: 4.2, 4.5 • 0 to 0.68: 4.3, 95% CI: 4.2, 4.5 • ≥0.68: 4.1, 95% CI: 4.0, 4.3; P-trend: 0.488 mean BMI (kg/m^2) • <-0.68: 15.9, 95% CI: 15.6, 16.1 • -0.68 to 0: 16.1, 95% CI: 15.8, 16.3 • 0 to 0.68: 16.2, 95% CI: 16.0, 16.5 • ≥0.68: 16.1, 95% CI: 15.8, 16.3; P-trend: 0.102	• Diet assessed with repeat measures (age 6, 12 months) using FFQ and maternal interview • Weight/Height measured and other outcomes via DXA • Cannot determine whether groups were similar at baseline on key characteristics • Cannot determine whether outcome assessors were blinded • Did not define age of introduction of complementary foods and beverages variable • Did not account for high loss to follow-up (55%) • **Funding**: Medical Research Council, University of Southampton, British Heart Foundation, Food Standards Agency

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Vadiveloo, 2019 [5] United States; Nurture Cohort Analytic N=449 **Participant characteristics:** SEP: 65.2% non-Hispanic Black; 59.3% low income (<$20K/year); 18.9% mothers <high school education Recruited mothers between 20 and 36 weeks' gestation; Excluded mothers <18 years; mothers without singleton pregnancy; without intention to remain in study area for at least 12 months; with missing dietary or outcome data	**Age at Dietary Pattern:** 4 to 12 months Healthy Food Score (HFS): Positive: Vegetables (no fried potatoes); Fruit (no 100% fruit juice) Unhealthy Food Score (UnHFS): Positive: French Fries; Ice cream; Baby Snacks; Sweets Healthiest (10 points) = ≥ 2 servings/d of foods in HFS AND ≤ 1 serving/d of foods in UnFS Moderately healthy (0 points) = ≥ 2 servings/day of foods in HFS AND ≤ 1 serving/day of foods in UnHFS Moderately unhealthy (−10 points)= > 2 servings/day of foods in HFS AND > 1 serving/day of foods in UnHFS Unhealthy (ref) (−20 points)= < 2 servings/day of foods included in HFS and > 1 serving/day of foods included in UnHFS **Method(s)**: Index or Score Analysis	**Age at Follow-up: 12 months** Weight-for-length z-score, mean [standard error] • HFS: Q1, 0.56 [0.09]; Q2, 0.64 [0.10]; Q3, 0.66 [0.09]; Q4, 0.73 [0.10]; p-trend=0.65 • UnHFS: Q1, 0.42 [0.09]; Q2, 0.63 [0.09]; Q3, 0.79 [0.09]; Q4, 0.75 [0.09]; p-trend=0.02 • Moderately unhealthy v. Unhealthy: 0.06, 95% CI: -0.17, -0.29 • Moderately healthy v. Unhealthy: -0.33, 95% CI: -0.63, -0.03, p<0.05 • Healthiest v. Unhealthy: 0.02, 95% CI: -0.30, 0.33	• Diet assessed with repeat surveys (at ages 6, 9, and 12 months) from maternal recall and based HFS and UnHFS scores on mean value from between age 4 and 12 months. • Insufficient data on attrition reported • **Funding**: National Institutes of Health, National Institutes of Diabetes and Digestive and Kidney Diseases

[a] Abbreviations: BMI, body mass index; FFQ, Food frequency questionnaire; HFS, healthy food score; NR, not reported; ref, reference group/category; SD, standard deviation; SEP/SES, Socioeconomic position/status; UK, United Kingdom

Table 7. Risk of bias for observational studies examining dietary patterns with varying amounts of ultra-processed food consumed by infants and young children up to age 24 months and growth, body composition and risk of obesity[a]

Article	Confounding	Exposure classification	Participant Selection	Post-exposure interventions	Missing data	Outcome measurement	Selection of the reported result	Overall
Abraham, 2012 [1]	High	Some concerns	Some concerns	Low	Some concerns	Some concerns	Some concerns	High
Agnihotri, 2021[2]	High	Low	Low	Low	High	Low	Low	High
Baird, 2008 [3]	High	Low	Low	Low	Some concerns	Some concerns	Some concerns	High
Robinson, 2009 [4]	High	Low	Low	Low	High	Low	Some concerns	High
Vadiveloo, 2019[5]	High	Low	Low	Low	High	Some concerns	Some concerns	High

[a] Possible ratings of low, some concerns, high, very high, or no information determined using the "Risk of Bias in Non-randomized Studies of Exposures (ROBINS-E)" tool (ROBINS-E Development Group (Higgins J, Morgan R, Rooney A, et al. Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E). Launch version, 1 June 2022. Available from: https://www.riskofbias.info/welcome/robins-e-tool.)

Children and adolescents

Twenty-five articles met inclusion criteria and examined the relationship between dietary patterns with varying amounts of UPF consumed by children and adolescents and growth, body composition, and risk of obesity (also see Table 4). All articles analyzed prospective cohort studies.[6-30]

Description of the evidence

Population

Studies examined dietary patterns varying in UPF consumed by participants ranging in age between 2 up to 19 years. Race and/or ethnic background of participants was reported as mostly or predominantly non-White and/or Hispanic in 3 articles and predominantly White and/or non-Hispanic in 5 articles. Information on socioeconomic position (SEP) of participants widely varied across studies.

Data from 18 different countries were represented across included articles (Australia; Belgium; Brazil; Cyprus; Estonia; France; Germany; Hungary; Ireland; Italy; Netherlands; Norway; Portugal; Spain; Sweden; United Kingdom; United States; Uruguay). Multiple articles from a single cohort study were included from the following studies: Avon Longitudinal Study of Parents and Children (ALSPAC),[9,27] the EDEN study [24,25], Generation XXI [14,15,20,28,29]; Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS (IDEFICS) and/or the Kiel Obesity Prevention Study (KOPS) [23,30] and the Pelotas Birth Cohort study.[11,12,17] Across these cohort studies, the different articles examined dietary patterns varying in UPF differently, such as per 100 grams or per 100 kcal increase, by different outcomes or ages, and/or by different exposure classifications for dietary patterns varying in UPF (e.g., derived scores by Nova classification groups).

Intervention/exposure and comparator

Dietary intake assessment methods included food frequency questionnaire (n=13), 24-hour recalls (n=5), and/or diet history/diaries or other methods (n=7). Dietary patterns varying in UPF were examined by deriving a priori score-based indices (e.g., alignment or adherence based on a pre-determined index/score),[7,9-13,17,18,21,28,29] and data-driven methods of pattern development such as factor/cluster analysis[6,8,16,19,22-27,30] or latent class analysis[15,20]Ten articles examined dietary patterns with different amounts of UPF, where UPF were defined by the Nova system. Exposure to UPF within a dietary pattern was based on contribution to total energy or weight and examined continuously (such as per 100 grams amount consumed) and/or categorically (such as by tertiles or quartiles).[7,9-13,17,18,28,29] Four articles examined consumption of a dietary pattern with UPF compared to different dietary pattern without or low in UPF.[14,15,19,20]

All included studies described the types of UPF contributing to the dietary pattern. However, the groupings of foods that were classified as UPF widely varied across studies. Common sources or types of UPF contributing to the dietary patterns included:

- sugar-sweetened beverages
- processed meats and meat products
- sugar-sweetened foods
- packaged salty/savory and/or sweet snack foods
- ready-to-eat meals and dishes

Outcomes

All of the included studies reported using standardized procedures to measure (in-person) body size and/or composition of participants. The following outcomes were reported in the included studies:

- Risk of overweight and/or obesity[19]
- BMI, BMI z-score, weight-to-height ratio, and/or weight-for-length z-score[6-10,12-16,18,19,23,24,28-30]

- Body composition (such as z-scores for fat mass, fat mass index, fat free mass, skinfold thickness) [10-15,24,25,27,29,30]
- Waist circumference (and waist circumference z-score or waist-hip-ratio)[7,10,12,14,15,20,29,30]
- Weight and/or height/length [9,12,19]

Synthesis of the evidence

This evidence synthesis focuses on the studies with fewer limitations, which included studies that: (1) were designed to directly examine dietary patterns that vary in UPF; (2) used 24-hour recall or dietary records to collect dietary intake of UPF; and (3) used a food processing classification system to categorize items as UPF; Across evidence, the direction of reported effect estimates were similar, regardless of statistical significance, and suggested that dietary patterns with higher relative to lower intakes of foods (either explicitly or likely) classified as UPF were associated with greater adiposity and/or risk of overweight.[6,9,12,18,28] Specifically, dietary patterns higher in UPF were associated with significantly greater waist circumference, fat mass index, body fat percentage,[9-11] BMI or BMIz-score,[9,12,18,28] weight and/or lower length/height for age z-score, [9,12] and risk of overweight.[26] Seven of these studies based UPF categorization on the Nova classification group 4. The amount or contribution of UPF was analyzed differently in each article and included continuously per 100g,[11] per SD,[26] per 10%,[10] or per 100 kcal[28] increments; by % weight,[9] or dichotomously as either 1300 kcal vs. 300 kcal [18] or 6 or more compared to 5 or less Nova 4 sub-groups.[12] The mean percent of total energy from UPF within dietary patterns consumed ranged from 27% to 42% among the studies reporting that information. One study reported a range of 1 to 27 servings/day from UPF across participants.[7] One study reported mean energy in kcal/day from UPF as 698 kcal/d.[18] One study reported the range of UPF items per day from 9 to 15.[13]

The magnitude of effect estimates across the body of evidence varied, but tended to be small (e.g., <10% relative risk). In addition, many of the articles reported both statistically significant results as well as comparisons or findings that did not reach statistical significance. For example, Vedovato and colleagues[28] found that a dietary pattern higher in UPF (per 100 kcal) at age 4 years, but not at age 7 years, was significantly associated with higher BMI z-score at age 10 years. In contrast, Heerman et al. 2023[18] observed that a dietary pattern with 1300 vs. 300 kcal from UPF in children at age 3 years or 4 years, but not at age 5 years, was significantly associated with higher BMI z-score at age ~ 6 to 8 years.

- Two articles each examined consumption of dietary patterns that were comprised primarily of foods/items likely classified as UPF.[6,27] Smith and colleagues[27] found that the 'Packed Lunch' dietary pattern at age 9 years was associated with higher fat mass gains in girls and less lean mass gain in boys at age 11 years (among valid-reporters). Results examining under-reporters were not statistically significant. Arruda and colleagues [6] found that the 'Western', but not the 'Snacks' dietary pattern, at age 10 to 14 years was significantly associated with higher BMI z-score at age 13-17 years.

- Two articles from the same cohort examined the 'Energy-dense foods (EDF)" dietary pattern comprised primarily of foods/items likely classified as UPF (e.g., soft drinks, salty pastry, sweets, processed meats) compared to the 'Healthier' dietary pattern (low in EDF components and comprised of non-processed foods such as fruits and vegetables).[14,15] Consuming the 'EDF' v. 'Healthier' dietary pattern at age 4 years was significantly associated with statistically higher risk of overweight or obesity, greater fat mass index, BMI z-score, and weight-to-height-ratio in girls; higher risk of overweight/obesity in boys at age 7 years[14] and higher BMI, fat mass index, weight-to-height-ratio and risk of obesity in girls at age 10 years.[15] However, no significant associations were found for fat mass percentage in girls or boys at either follow-up, and for most outcomes in boys (BMI z-score, fat mass index, weight-to-height-ratio) at both follow-up points.

Two articles reported that dietary patterns with minimal or no UPF were associated with lower BMI z-score, waist circumference,[7,29] and fat mass z-score.[29] Vilela and colleagues[29] found that consumption of less/minimal

UPF (Nova 2+1 per 100g) was significantly associated with lower fat mass z-score, BMI z-score, waist circumference z-score at age 10 years. No significant associations were reported when examining dietary patterns based on Nova 3 classification of foods in relation to outcomes. No significant associations were found between consumption of more UPF (Nova 4 per 100g) and fat mass z-score, BMI z-score, waist circumference z-score at age 10 years. Also, none of the dietary patterns examined in this article were associated with fat-free mass z-score. Bawaked and colleagues[7] found that consuming less vs. more UPF (medium or low UPF compared to high UPF based on Nova) at age 4 years associated with lower waist circumference at age 7 years, but this was not statistically significant.

One article reported that a dietary pattern higher in UPF was associated with lower BMI and body fat percentage, but complete data were not reported.[13] Cunha and colleagues[13] found that consuming more vs. less UPF (Q4 vs. Q1 Nova 4) at mean age 15.7 years was significantly associated with lower BMI and lower body fat percentage after 3-year follow-up. Notably, values and/or data supporting those results were not reported. In addition, total energy intake and BMI at baseline were lower in those with the highest consumption levels of UPF.

Findings that were not statistically significant (or mostly non-significant) between dietary patterns with varying amounts of UPF and outcomes generally supported a similar direction as significant results described above.

- González and colleagues[17] found that consuming greater amounts of UPF (Nova 4 per 100g) at age 24.4 months was not significantly associated with incidence of obesity at age 47.8 months.
- Saldanha-Gomes and colleagues[25] reported that consumption of a dietary pattern comprised of many UPF at age 2 years' was associated with higher risk of early adiposity rebound at age 5.5 years, but this result did not reach statistical significance. In another article by Saldanha-Gomes and colleagues,[24] consumption of that dietary pattern at age 2 years was not associated with BMI or % body fat at age 5 years.
- Wolters and colleagues[30] found that consumption of a dietary pattern at age 5-7 years (labelled “Fast-food”) was not associated with BMI, fat mass index, or weight-to-height ratio at age 9-11 years. Change toward greater consumption of that pattern from baseline to follow-up was significantly associated with greater fat mass index at follow-up but not with BMI or weight-to-height ratio. Additionally, consumption of a different pattern at age 5-7 years (labelled, “Snack”) was not associated with fat mass index and weight-to-height ratio, but weakly associated with higher BMI at follow-up 2 years later. Change toward greater consumption of that pattern from baseline to follow-up was not associated with BMI, fat mass index, or weight-to-height ratio at follow-up.
- Biazzi and colleagues[8] found that consuming “DP II” comprised of foods mostly classified as UPF, at age 7-10 years was not significantly associated with change in BMI z-score at age 12-15 years.
- Gasser and colleagues[16] found that consuming the ‘Unhealthy’ dietary pattern, comprised of “snacks, sugary drinks, and other UPF”, at age 4-5 years was not significantly associated with BMI z-score or weight-to-height ratio at age 14-15 years. In addition, this dietary pattern at age 2-3 years was not significantly associated with BMI z-score at age 10-11 years, but it was (weakly) associated in some waves with higher weight-to-height ratio at age 10-11 years.
- Hennessy and colleagues[19] found no significant difference in body weight, weight z-score, height, height z-score, BMI, BMI z-score, prevalence of overweight, prevalence of obesity, prevalence of overweight/obesity, or prevalence of underweight at age 5 years between consumption of the ‘Low Nutrient-Density' dietary pattern, which was comprised of confectionary, processed meat, and convenience foods compared to the ‘Traditional’ dietary pattern of whole meal breads, fresh meat, and fruit at age 2 years.

- Marks and colleagues[21] found that consuming a dietary pattern including chips and other snacks, candies, and other UPF, at age 11-13 years was not significantly associated with prevalence of overweight/obesity 1 year later.
- Oellingrath and colleagues[22] found that consuming a dietary pattern characterized by high-energy processed fast foods, refined grains, cakes and sweets at age 12-13 years was not significantly associated with prevalence of overweight 3 years later in those with healthy weight at baseline, nor in those with overweight at baseline.
- Pala[23] found that consumption of a dietary pattern comprised of street foods, savory pastries, and chocolate bars (‘Snacking’) or a dietary pattern of chocolate spreads, biscuits and sweets/candy, fried meat, and soft drinks (‘’Sweet’), at age 2-10 years were not associated with risk of overweight/obesity or change in BMI approximately 2 years later.
- Marinho[20] found no significant association between the EDF pattern described previously (primarily items likely to be UPF such as soft drinks, salty pastry, sweets, processed meats) compared to a ‘Healthier’ dietary pattern (low in EDF components and comprised of non-processed foods such as fruits and vegetables) and waist-to-weight ratio as a mediator of intelligence quotient.

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question based on their review of evidence examining dietary patterns with varying amounts of UPF consumed during childhood and adolescence and measures of growth, body composition, and risk of overweight/obesity (Table 8).

Table 8. Conclusion statement, grades for dietary patterns with varying amounts of ultra-processed food consumed by children and adolescents and growth, body composition, and risk of obesity.

Conclusion Statement	**Dietary patterns consumed by children and adolescents with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)**
Grade	Limited
Body of Evidence	26 articles from prospective cohort studies
Consistency	Some concerns due to variation in the magnitude and direction of effect estimates
Precision	Serious concerns with relatively smaller sample sizes and wide variance around effect estimates
Risk of bias	Serious concerns due to potential confounding, exposure misclassification, and not accounting for missing data
Directness	Serious concerns that not all of the dietary patterns examined were directly varying in amounts of UPF
Generalizability	Participant characteristics, dietary patterns, and outcomes likely generalize but there were serious concerns with applicability of UPF to the U.S. population given the inconsistencies in amounts and types of UPF available in the countries and time periods included in the studies.

Assessment of Evidence

This body of evidence includes studies with both larger and smaller sample sizes as well as null findings, which makes publication bias less likely. As outlined and described below, the body of evidence was assessed for the following elements used when grading the strength of evidence.

Consistency:

The direction of findings were similar regardless of statistical significance suggesting that dietary patterns higher in foods classified as UPF were associated with a higher risk of overweight and/or greater BMI, waist circumference, and/or fat mass. However, the size of effects ranged widely and confidence intervals often included the null. Only one article reported results in the opposite direction, but those findings were likely explained by methodological inconsistencies.

Precision:

Studies ranged in analytic sample sizes from n=243 to n=9,427. Several articles had either smaller sample sizes, minimal variability between the exposure and comparator to detect an effect, and/or limited number of events .

Risk of bias

Various potential sources of bias were identified (**Table 5**). Most of the key confounders were accounted for across studies, with exception of race and/or ethnicity of participants. Studies that classified UPF based on a single baseline diet assessment are more prone to misclassification of their usual intake over time, particularly among children. Assessment of foods and beverages as UPF from food-frequency questionnaires has not been validated in all studies and may also contribute to potential exposure misclassification. All of the studies objectively measured the outcomes, but several articles did not account for missing data in the analysis.

Directness:

Studies using Nova classification of UPF were more direct in addressing the relationship of interest compared to the studies that used factor/cluster/latent class methods for deriving dietary patterns. Studies that used *a posteriori* methods were not directly intending to examine variation in UPF, but rather examine consumption of dietary patterns comprised of many foods often consumed in highly processed versions and/or likely to be classified as UPF with few exceptions. No studies directly compared dietary patterns with the same types of foods in a non-ultra-processed compared to ultra-processed version.

Generalizability:

Only one study was conducted in the United States. Socioeconomic position of participants varied across studies and was most commonly based on parental education. Most of the dietary patterns compared and components among the dietary patterns are commonly consumed in the United States, such as cookies, cakes, candy/confectionary, luncheon (cold) meats, nuggets, fish sticks, and sugar-sweetened beverages, with relatively few elements that may be less generalizable such as curry-sausage or muesli. Outcomes were generalizable to those experienced in the United States population.

Table 9 Studies examining the relationship between dietary patterns with varying amounts of ultra-processed food consumed in children and adolescents and growth, body composition and composition and risk of obesity[a]

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Arruda, 2021 [6] PCS; Brazil N=773 **Participant data:** • ~82% non-White, 18% White skin-colour • 100% Brazilian • ~50% middle-economic class; 32% maternal education > HS • Enrolled 6th graders in municipality of Joao Pessoa; • Excluded those <10 and >14 y, with disability limiting PA or responding to questionnaires, who were pregnant, with lack of anthropometric measurements, lack of 24-h recall data, LFU	**Age at dietary pattern: 10 to 14 years** • ‘Snacks': positively correlated with intake of processed meats, butters and margarines, breads and breakfast cereals, cheeses, and coffee and teas; • 'Western': positively correlated with intake of sweets, pastries, sweetened drinks, cheese; negatively with coffee and teas **Method:** Factor/Cluster Analysis	**Age at outcome: 13 to 17 years** **Results:** BMI z-score • 'Snacks': β=-0.014, 95% CI: -0.033, 0.005 • 'Western': β=0.024, 95% CI: 0.001, 0.047	• Did not account for: Race/ethnicity (Brazilian 6th graders) • Diet assessed with 24-hour recall at baseline, and a 2nd 24-hour recall in 30% of all waves; Outcomes objectively measured in triplicate (via WHO age/sex-specific BMI) • Funding: São Paulo Research Foundation
Bawaked, 2020 [7] PCS; Spain N=1480; 1256 BMI, 1248 WC **Participant data:** • Spanish • Social class: 24% I/II; 29% III; 47% IV; M. Education: 22% low, 41% 2nd, 36% Uni. • Included mothers	**Age at dietary pattern: 4 years** "Ultra-processed" food (UPF, Nova food classification system, group 4 [Monteiro, 2019]) e.g. Carbonated drinks, processed meat, biscuits [cookies], candy [confectionery], ‘instant’ packaged soups and noodles, sweet or savory packaged snacks, and sugared milk and fruit drinks. **Method:** Index/Score Analysis	**Age at outcome: 7 years** **Results:** UPF (High, ref) & BMI z-score • Med UPF, β: -0.04, 95% CI: -0.15, 0.06 • Low UPF, β: -0.10, 95% CI: -0.20, 0.01 • p=0.07 UPF (High, ref) & Waist circumference • Med. UPF, β: -0.05, 95% CI:-0.18, 0.07 • Low UPF, β: -0.08, 95% CI: -0.21, 0.04 • p=0.18	• Did not account for: Race/ethnicity; Physical Activity (modelled as independent variable of interest); TEI • Diet assessed once via FFQ at age 4 years for past 12 months; Misclassification possible; Outcomes objectively measured • Funding: Instituto de Salud Carlos III; EU Commission; Generalitat Valenciana; Generalitat de Catalunya-CIRIT; Department of

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
≥16years old, delivering at referene hospital, Spanish/regional language, singelton pregnanc without assisted conception, children with relevant data (physical activity, sedentary activity, dietary, BMI/WC)			Health of the Basque Government; Provincial Government of Gipuzkoa; Fundació La marató de TV3
Biazzi, 2017 [8] PCS; Brazil N=458 (1158 baseline) **Selection/Participant data:** • Income, mo.: 47% <3; 27% 3-5; 15% 5-10; 11% >10 • Excluded those with extreme dietary intake (outlier)	**Age at dietary pattern: 7 to 10 years** 'DP II': Salty snacks, French fries, fast-food, Sugary beverages **Method:** Factor/Cluster Analysis	**Age at outcome: 12 to 15 years** **Results:** • DP II & Δ BMI z-score, Coefficient: 0.02; Effect size: 0.00, p=0.45	• Did not account for: Race/Ethnicity • Diet assessed with 1-day recall questionnaire at baseline and F/U; Outcomes objectively measured by trained staff (BMI z-score via WHO age/sex-specific BMI); • Accounted for missing data via testing those with F/U v. LFU • Funding: Brazilian National Council for Scientific and Technological Development
Chang, 2021 [9] PCS; United Kingdom N=9025 **Selection/Participant data:** • 90% 'White', 9% 'Non-White', 2% 'missing' ; UK-birth-cohort • ~30% higher, ~30% intermediate, ~30% lower, 10% missing info on SEC • Pregnant women with an expected delivery date between April 1991 and Dec. 1992; Excluded those missing	**Age at dietary pattern: 7 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g. Soft drinks; sweet or savoury packaged snacks; ice cream, chocolate, candies; massproduced packaged breads and buns; margarines and spreads; cookies, pastries and cake mixes; breakfast cereals and cereal/energy bars; milk, cocoa and fruit drinks; meat and chicken extracts and instant sauces; infant formulas, follow-on milks and other baby products; ready-to-heat/eat products and dishes (pies, pasta, pizza, desserts); processed meats and sausages;	**Age at outcome: 24 years** **Results:** UPF Q1, HR: 0, ref BMI: Q5 vs. Q1, HR: 1.18, 95% CI: 0.78, 1.57 • Q2, HR: 0.06, 95% CI: −0.10, 0.23 • Q3, HR: 0.006, 95% CI: −0.16, 0.17 • Q4, HR: 0.02, 95% CI: −0.15, 0.19 • Q5, HR: 0.08, 95% CI: −0.09, 0.24 BMI z-score • Q2, HR: 0.06, 95% CI: −0.01, 0.13 • Q3, HR: 0.03, 95% CI: −0.04, 0.10 • Q4, HR: 0.05, 95% CI: −0.02, 0.12 • Q5, HR: 0.05, 95% CI: −0.02, 0.12 Body fat %: Q5 vs. Q1, HR: 1.53, 95% CI: 0.81, 2.25 • Q1, ref, HR: 0	• Did not account for: n/a (all accounted for) • Diet assessed with 3-day food diary at multiple points (age 7, 10, 13 years); Outcomes objectively measured by trained staff (BMI z-score calculated/defined via Cole 1990 British Growth charts) • Funding: UK Medical Research Council; Wellcome Trust; University of Bristol

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
dietary data and/or outcome data	packaged soups and noodles; flavoured and/or artificial sweetened yoghurt **Method:** Index/Score Analysis	• Q2, HR: 0.65, 95% CI: −0.01, 1.30 • Q3, HR: 0.67, 95% CI: 0.02, 1.32 • Q4, HR: 1.02, 95% CI: 0.35, 1.67 • Q5, HR: 1.47, 95% CI: 0.81, 2.13 FMI: Q5 vs. Q1, HR: 0.78, 95% CI: 0.46, 1.08 • Q2, HR: 0.08, 95% CI: −0.09, 0.26 • Q3, HR: 0.11, 95% CI: −0.06, 0.28 • Q4, HR: 0.17, 95% CI: −0.01, 0.34 • Q5, HR: 0.27, 95% CI: 0.09, 0.45 Fat mass, kg • Q2, HR: 0.11, 95% CI: −0.31, 0.52 • Q3, HR: 0.10, 95% CI: −0.32, 0.51 • Q4, HR: 0.20, 95% CI: −0.22, 0.62 • Q5, HR: 0.51, 95% CI: 0.08, 0.93 Lean mass index • Q2, HR: 0.005, 95% CI: −0.06, 0.07 • Q3, HR: 0.009, 95% CI: −0.06, 0.07 • Q4, HR: −0.01, 95% CI: −0.08, 0.05 • Q5, HR: −0.01, 95% CI: −0.08, 0.05 Lean mass, kg • Q2, HR: 0.13, 95% CI: −0.16, 0.42 • Q3, HR: −0.01, 95% CI: −0.30, 0.28 • Q4, HR: −0.07, 95% CI: −0.36, 0.23 • Q5, HR: 0.07, 95% CI: −0.23, 0.37 Waist circumference, cm: Q5 vs. Q1, HR: 3.08, 95% CI: 2.08, 4.06 • Q2, HR: 0.26, 95% CI: −0.14, 0.66 • Q3, HR: 0.03, 95% CI: −0.36, 0.42 • Q4, HR: 0.22, 95% CI: −0.18, 0.62 • Q5, HR: 0.16, 95% CI: −0.25, 0.56 Weight, kg: Q5 vs. Q1, HR: 3.66, 95% CI: 2.18, 5.12 • Q2, HR: 0.35, 95% CI: 0.007, 0.69 • Q3, HR: 0.30, 95% CI: −0.03, 0.63 • Q4, HR: 0.34, 95% CI: −0.007, 0.68 • Q5, HR: 0.30, 95% CI: −0.04, 0.65	

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Costa, 2019 [10] PCS; Brazil N=315 **Selection/Participant data:** • 57% Non-White • 100% low SES: 71% ≤ \$3,000/y; 35% mothers employed, 89% fathers employed; 56% of mothers/fathers had < 8y education • Excluded those with HIV+, congenital disease, NICU stays, not from maternity ward of low-income hospital in urban Brazil	**Age at dietary pattern: 4 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]) by % TEI contribution: Highest in Sweets (candy, chocolate, ice cream); Breads; Biscuits (crackers and cookies); Soft drinks (soda, sweetened juice and sports drinks); Powdered chocolate; Savory chips and Salty snacks; Processed meat; Sugary Milk beverages; Instant noodles, dehydrated soup, mayonnaise, dressing/sauces; Breakfast cereals (lowest mean intake at age 4y) **Method:** Index/Score Analysis	**Age at outcome: 8 years** **Results:** • UPF per 10% & Δ BMI, β: 0.00, 95% CI: -0.02, 0.01; p=0.732 • UPF per 10% & Δ Skinfold thickness, β: 0.04, 95%CI: -0.05, 0.14; p=0.377 • UPF per 10% & Δ Waist circumference, β: 0.06, 95% CI: 0.01, 0.13; p=0.046 • UPF per 10% & Δ Waist-to-Height Ratio, β: 0.00, 95%CI: 0.00, 0.00; p=0.089	• Did not account for: Age, Race/Ethnicity, Physical activity (did screen time) • Diet assessed with 24-hour recall at 4 and 8 years from self-report with help of parent; Outcomes objectively measured; • Funding: Brazil National Council for Scientific and Technological Development
Costa, 2021 [11] PCS; Brazil Analytic N=3128 **Selection/Participant data:** • 73% 'white skin colour'; 27% 'black/brown/yellow/indigenous skin colour' • maternal education: 16% 0-4y, 41% 5-8y, 33% 9-11y, 10% 12y+ • Newborns in urban Pelotas/Jardim within Gapao do Leao	**Age at dietary pattern: 6 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]): Sweet cookies; salty cracker; yogurt or milk drink; ham; mortadella; sausage; butter or margarine; mayonnaise; candies, lollipop or chewing gum; chocolate bar or bonbon; ice cream or popsicle; chocolate powder; sugar sweetened beverages; artificially sweetened beverages (light, diet or zero); artificial juice (powder or box); salty snacks; sandwich cookies; gelatin. **Method:** Index/Score Analysis	**Age at outcome: 6-11 years** **Results:** • UPF & Δ Fat mass index 6-11y: β: 0.14, 95% CI: 0.13, 0.15; p<0.001 (adj. non-UPF) • UPF & Δ Fat mass index 6-11y: β: 0.05, 95% CI: 0.04, 0.06; p<0.001 (adj. TEI)	• Did not account for: Age, birthweight but not anthropometry at baseline (assessed change from 6-11 years as main result) • Diet assessed via FFQ at 6 years (parent-report) and 11 years (parent w/ child help); Misclassification possible; Outcomes objectively measured; • Moderate effect size per 100g increase in UPF was associated with 0.14 kg/m2 of fat mass index increase from 6 to 11 years; 58% of effect of UPF on fat mass index due to mediation from TEI (42% direct effect UPF) • Funding: Wellcome Trust; Departamento de Cieˆncia e Tecnologia; Conselho Nacional de Desenvolvimento Cientı´fico e Tecnolo´ gico- Brazil

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Costa, 2022 [12] PCS; Brazil; N=3498 **Selection/Participant data:** • 70% 'white', 13% 'brown', 17% 'black skin colour' • Wealth index, ~20% (each Q1 (poorest) through Q5 (richest)); Maternal education mean 10 years (SD: 3.9) • Newborns in urban Pelotas/Jardim within Gapao do Leao	**Age at dietary pattern: 2 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]): 9 sub-groups: i) Instant noodles 30%; (ii) Soft drinks 37%; (iii) Chocolate powder (in milk) 43%; (iv) Nuggets, hamburger or sausages 43%; (v) Salty snacks, packaged 46%; (vi) Candies, lollipops, chewing gum, chocolate or jelly 65%; (vii) Cookie (sandwich-type) or Sweet Biscuit 65%; (viii) Juice from can, box, or powder 67%; (ix) Yogurt 88% **Method:** Index/Score Analysis	**Age at outcome: 4 years** **Results:** UPF & BMI-age-z (BAZ), T1, ref • cont. β: 0.02, 95% CI: 0.01, 0.03; p<0.001 • T2, β: 0.05, 95% CI: -0.01, 0.11 • T3, β: 0.01, 95% CI: -0.06, 0.07 • p=0.207 • 6+ vs. ≤ 5 of 9 sub-groups & BAZ, β: 0.09, 95% CI: 0.04, 0.14; p<0.001 UPF & Length or Height-for-age- z-score, T1, ref • cont. β: -0.03, 95% CI: -0.04, -0.02; p<0.001 • T2, β: -0.04, 95% CI: -0.08, 0.01 • T3, β: -0.06, 95% CI: -0.11, -0.01 • p=0.023 • Yes or No to 6+ sub-groups, β: -0.10, 95% CI: -0.14, -0.06; p<0.001	• Did not account for: Age; TEI • Diet assessed via FFQ at 2 years and 4 years; Misclassification possible (Y/N usually consuming 9 sub-groups); Outcomes objectively measured; Precision when UPF was analyzed continuously • Funding: Wellcome Trust; Conselho Nacional de Desenvolvimento Cientı´fico e Tecnolo´ gico- Brazil; Fundação de Amparo a Pesquisa do Estado do Rio Grande do Sul; Children's Pastorate; Bernard van Leer Foundation
Cunha, 2018 [13] PCS; Brazil; N=1035 **Selection/Participant data:** • Data NR (Brazilian) • Excluded those with pregnancy or physical disability, w/ obesity at baseline; Included 1st year high-school students from 4 private and 2 public urban schools	**Age at dietary pattern: 15.7 years, mean (13.5-19.5 years)** UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g. Sodas; Fruit drinks; Candies; Cookies; Chocolate milk beverages; Guarana (soda); Packed fruit juices; Ham; french fries; Sweet Pastries; Chocolate; Chips; Fried, filled rolls; Oven-baked rolls; Instant pasta; Ice cream; Jelly; Nuggets; Hamburger; Pizza; Hot dog; Cheese rolls **Method:** Index/Score Analysis	**Age at outcome: 16.6 years (14.4-19.8); 17.6 years (15.3-20.9)** **Results:** • UPF Q4 v. Q1 associated with lower BMI at 3 year F/U (values/data NR); • No interaction between age and UPF & BMI (p=0.07); Under-reporting of UPF intake (coefficient=-0.94) and PA (coefficient=-1.0) associated with BMI at F/U • UPF Q4 v. Q1 associated with lower body fat % at 3 years F/U (values/data NR); • No interaction between age and UPF & body fat % (p=0.07)	• Did not account for: Race and/or ethnicity; SEP • Diet assessed once via (valid) FFQ; Misclassification possible; Outcomes objectively measured by trained staff; Lower TEI in Q4 of UPF possibly mediated – Q4 v. Q1 of UPF at baseline also had lower BMI & body fat % • Funding: National Council for Scientific and Technological Development; Research Support Foundation of the State of Rio de Janeiro; Coordination for Improvement of Higher Education Personnel

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Durao, 2017 [14] PCS; Portugal; N=3473 **Selection/Participant data:** • Data NR (Portuguese birth cohort) • Excluded those with diseases that influence diet, missing data	**Age at dietary pattern: 4 years** • 'Energy dense foods' (EDF): Sweets, soft drinks, salty pastry, processed meat • 'Healthier': higher consumption of fruit, vegetables, vegetable soup, and fish; lower EDF **Method:** Latent Class Analysis	**Age at outcome: 7 years** **Results:** 'EDF' v. 'Healthier' ref (SS: linear regression coefficient) Overweight/Obesity • ♀ SS: 1.48, 95 % CI: 0.96, 2.29 • ♂ SS: 3.15, 95 % CI: 1.54, 6.45 BMI • ♀ SS: 0.074, 95 % CI: 0.002, 0.146 • ♂ SS: 0.021, 95 % CI: -0.055, 0.097 Fat mass, % • ♀ SS: 0.045, 95 % CI: -0.026, 0.116 • ♂ SS: 0.02, 95 % CI: -0.053, 0.093 Fat mass index • ♀ SS: 0.078, 95 % CI: 0.011, 0.145 • ♂ SS: 0.029, 95 % CI: -0.040, 0.098 Waist-hip-ratio • ♀ SS: 0.108, 95 % CI: 0.028, 0.187 • WHR ♂ SS: 0.025, 95 % CI: -0.050, 0.1	• Did not account for: Race/ethnicity • Diet assessed once via FFQ at baseline (only validated in adults); Outcomes objectively measured (BMI z-score via WHO age/sex-specific BMI) • Funding: Programa Operacional de Saúde (Regional Department of Ministry of Health); Portuguese Foundation for Science and Technology (FCT) and by the Calouste Gulbenkian Foundation; FEDER from the Operational Programme Factors of Competitiveness—COMPETE and through
Durão, 2022 [15] PCS; Portugal; N=1861 ♀; 1962 ♂ **Selection/Participant data:** • Data NR (Portuguese birth cohort) • Excluded those with conditions that affect dietary intake, incomplete data at 4y on PA, screen time, or maternal BMI, and no BP data at 10y	**Age at dietary pattern: 4 years** • 'Energy dense foods' (EDF): Sweets, soft drinks, salty pastry, processed meat • 'Healthier': higher consumption of fruit, vegetables, vegetable soup, and fish; lower EDF **Method:** Latent Class Analysis	**Age at outcome: 10 years** **Results:** 'EDF' v. Healthier (OR: 1 ref) and Risk of overweight, • ♀ OR: 1.48, 95% CI: 0.96, 2.29 • OW, ♂ OR: 1.01, 95% CI: 0.66, 1.53 Risk of obesity, • ♀ OR: 3.15, 95% CI: 1.54, 6.45 • ♂ OR: 1.16, 95% CI: 0.62, 2.18 BMI • ♀, β: 0.074, 95% CI: 0.002, 0.146 • ♂, β: 0.021, 95% CI: -0.055, 0.097 Fat mass, % • ♀, β: 0.045, 95% CI: -0.026, 0.116 • ♂, β: 0.020, 95% CI: -0.053, 0.093 Fat mass index • ♀ β: 0.078, 95% CI: 0.011, 0.145	• Did not account for: Race/ethnicity • Diet assessed once via FFQ at baseline (only validated in adults); Outcomes objectively measured (BMI z-score via WHO age/sex-specific BMI) • Funding: Health Operational Programme–Saúde XXI, Community Support Framework III, Regional Department of Ministry of Health, FEDER–COMPETE, the Foundation for Science and Technology–FCT, a Researcher Contract, Epidemiology Research Unit and Laboratory

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
		• ♂ β: 0.029, 95% CI: -0.040, 0.098 Waist-hip-ratio • ♀ β: 0.108, 95% CI: 0.028, 0.187 • WHR ♂ β: 0.025, 95% CI: -0.050, 0.100	
Gasser, 2019 [16] PCS; Australia; N=2009 to 2014 **Selection/Participant data:** • 4-5% Indigenous Australian • Socioeconomic Index: 13-19% Q1 (richest), 17-18% Q2, 20% Q3, 21% Q4, 23% Q5 (poorest) • All participants were enrolled in Australia's Medicare database	**Age at dietary pattern: 2 to 3 years, B cohort; 4 to 5 years, K cohort** 'Unhealthy': Positive: savoury snacks and sweetened drinks in all waves; meat pies, hamburgers, hot dogs, sausages or sausage rolls, hot chips and fruit juice in most waves; sugary foods, diet drinks, energy drinks, coffee and soya milk products mainly in the later waves; Negative: water in six of the eleven waves **Method:** Factor/Cluster Analysis	**Age at outcome: 10 to 11 years, B Cohort; 14 to 15 years K Cohort** **Results:** BMI z-score K cohort, • Wave (W) 2, β: -0.01, 95% CI: -0.04, 0.02; p-trend=0.47 • W 3, β: -0.01, 95% CI: -0.04, 0.02; p-trend=0.42 • W4, β: 0.01, 95% CI: -0.02, 0.03; p-trend=0.52 • W5, β: 0.01, 95% CI: -0.03, 0.04; p-trend=0.73 B cohort, • W2, β: 0.02, 95% CI: -0.03, 0.06; p-trend=0.46 • W3, β: 0.01, 95% CI: -0.03, 0.05; p-trend=0.54 • W4, β: 0.02, 95% CI: -0.01, 0.05; p-trend=0.24 • W5, β: 0.01, 95% CI: -0.02, 0.05; p-trend=0.37 Weight-to-Height ratio K cohort,	• Did not account for: n/a (all accounted for) • Diet assessment at multiple times using non-validated tool; Outcomes objectively measured by trained staff; Derived dietary pattern scores for each child at each wave (0-1 years B-Cohort; 4-5 years K Cohort); • Funding: Department of Social Services, Australian Institute of Family Studies, Australian Bureau of Statistics

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
		• W2, β: -0.01, 95% CI: -0.04, 0.02; p-trend=0.47 • W3, β: -0.02, 95% CI: -0.06, 0.02; p-trend=0.40 • W4, β: -0.03, 95% CI: -0.06, -0.00; p-trend=0.03 • W5, β: -0.05, 95% CI: -0.09, -0.00; p-trend=0.03 B cohort, • W2, β: 0.01, 95% CI: -0.03, 0.05; p-trend=0.62 • W3, β: 0.04, 95% CI: 0.00, 0.07; p-trend=0.03 • W4, β: 0.03, 95% CI: 0.00, 0.06; p-trend=0.03 • W5, β: 0.04, 95% CI: 0.00, 0.07; p-trend=0.03	
González, 2023 [17] PCS; Brazil; Uruguay; N=6468; 2550 (ENDIS), 3918 (Pelotas) **Selection/Participant data:** • NR (all Latin-American) • Education: 48% of mothers had 6-12y • ENDIS cohort: included children <4 y at baseline with complete data • Pelotas cohort: children recruited at birth; included those wih two BMI measurements	**Age at dietary pattern: 2 years (~25 months)** <u>UPF</u> (Nova food classification system, group 4 [Monteiro, 2019]) main sources: Cookies; Packaged dairy deserts; Sweetened Drinks; Cookies; Processed Meat products **Method:** Index/Score Analysis	**Age at outcome: 4 years (~48 months)** **Results:** UPF (baseline and current) & Incident Obesity, RR: 1.02, 95% CI: 0.93, 1.12; p=0.680	• Did not account for: Physical activity; Race/Ethnicity ('Latin-American') • Diet assessed once with 24-hour recall (wave 1 ENDIS) or FFQ (wave 2 ENDIS, Pelotas); Different diet assessment methods between waves & cohorts and UPF intake based on FFQ; Outcomes objectively measured • Funding: National Agency of Investigation and Innovation; Wellcome Trust; Conselho Nacional de Desenvolvimento Cientı´fico e Tecnolo´ gico- Brazil; Fundação de Amparo a Pesquisa do Estado do Rio Grande do Sul; Children's Pastorate

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Heerman, 2023 [18] PCS; United States; N=595 **Selection/Participant data** • 91.3% Hispanic; 8.7% Non-Hispanic • 57.5% food secure; 42.5% food insecure; • 88% use WIC/SNAP, 12% do not use WIC/SNAP; • Enrolled parent-child pairs qualified for ≥ 1 under-served population service (e.g., WIC), normal to overweight/obesity (BMI 50th-95th %tile); spoke English/Spanish; telephone access; free of medical conditions precluding PA	**Age at dietary pattern: 4.3 years, mean; 3 to 5 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g. Soft drinks; sweet or savoury packaged snacks; ice cream, chocolate, candies; massproduced packaged breads and buns; margarines and spreads; cookies, pastries and cake mixes; breakfast cereals and cereal/energy bars; milk, cocoa and fruit drinks; meat and chicken extracts and instant sauces; infant formulas, follow-on milks and other baby products; ready-to-heat/eat products and dishes (pies, pasta, pizza, desserts); processed meats and sausages; packaged soups and noodles; flavoured and/or artificial sweetened yoghurt **Method:** Index/Score Analysis	**Age at outcome: ~6 to 8 years (F/U 36 months)** **Results:** UPF high v. low & BMI z-score • 3 year olds: 1.2, 95% CI: 0.5, 1.9; p<0.001 • 4 year olds: 0.6, 95% CI: 0.2, 1.0; p=0.007 • 5 year olds: -0.1, 95% CI: -0.6, 0.4; p=0.7 • All (ages 3 to 5 years): 0.4, 95% CI: -0.02, 0.7; p=0.07	• Did not account for: Anthropometry at baseline (tested BMIz) • Diet assessed once with 24-hour-recall; mean daily calories from UPF in sample >60%; Outcomes objectively measured (BMIz via WHO age/sex-specific BMI); mean daily calories from UPF in sample >60% • Funding: NHLBI
Hennessy, 2023 [19] PCS; Ireland; N=375 **Selection/Participant data** • 99% Caucasian • 89% 3rd -level education; 96% married or living with partner • Included low-risk, nulliparious with singleton <15wk gestation	**Age at dietary pattern: 2 years** • **'**Low Nutrient Density' (LND): confectionary, processed meat, convenience foods • 'Traditional': wholemeal breads, butter, fresh meat, fruit **Method:** Factor/Cluster Analysis	**Age at outcome: 5 years** **Results:** 'LND' v. 'Traditional' dietary pattern: • %Overweight/Obesity, WHO: 1.1 v. 4.7% • % Overweight, IOTF: 9.5 v. 11.3% • % Obesity, IOTF: 1.1 v. 0.9% • % Underweight, IOTF: 3.2 v. 3.8% • BMI, mean [SD] (kg/m2): 16 [1.3] v. 16 [1.3] • BMI z-score, mean [SD]: 0.2 v. 0.3 [0.9] • Weight [SD], kg: 19.4 [2.3] v. 19.6 [2.4] • Weight-z [SD]: 0.2 [0.9] v. 0.3 [0.9] • Height [SD], cm: 110.2 [4.1] v. 110.4 [4.3] • Height, z-score: 0.1 [0.9] vs. 0.1 [0.9]	• Did not account for: Age, Physical activity, SEP (89% 3rd) • Diet assessed once (baseline) with 2-day weighed, record; Outcomes objectively measured (IOTF and WHO) • Funding: Irish Dept. of Agriculture, Food and the Marine; National Children's Research Centre

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Marinho, 2022 [20] PCS; Portugal; N=3575 **Participant characteristics:** • Data NR (Portuguese birth cohort) • Excluded pre-term children, children with a disease influencing dietary intake or congenital anomalies, children with characteristics that influence cognitive assessment, and missing data	**Age at dietary pattern: 4 years** • ‘Energy-dense foods (EDF)': high intakes of sweets, sugar-sweetened beverages, savory pastry, and processed meat. • 'Healthier': higher consumption of fruit, vegetables, vegetable soup, and fish, with a lower consumption of EDF **Method:** Factor/Cluster Analysis	**Age at outcome: 10 years** **Results:** Weight-to-waist ratio, from mediation to IQ • Full Scale IQ: β: 0.032, 95% CI: -0.015, 0.082 • Performance IQ: β: 0.032, 95% CI: -0.017, 0.079 • Verbal IQ: β: 0.032, 95% CI: -0.017, 0.087 • Processing Speed IQ: β: 0.032, 95% CI: -0.021, 0.092	• Did not account for: Anthropometry at baseline, Age, Race/Ethnicity (100% Portuguese birth cohort) • Diet assessed once via FFQ at age 4 years, tested agains 3-day diaries in sub-sample; Misclassification possible due to UPF intake based on FFQ; Outcomes objectively measured, calculated and defined via WHO; Indirect design (IQ main outcome) via mediation analysis of DP & adiposity impacting IQ • Funding: Health Operational Programme - Saúde XXI, Community Support Framework III and the Regional Department of Ministry of Health, Calouste Gulbenkian Foundation, by FEDER from Operational Programme Factors of Competitiveness, Epidemiology Research Unit
Marks, 2015 [21] PCS; Australia; N=243 **Selection/Participant data** • 85% Austrailian-born; No significant differences by ehtnicity were found • Enrolled schools only from bottom-2 of SES strata	**Age at dietary pattern: 11 to 13 years, mean 12.2 years** Non-core food score [Marks, 2015], Positive: potato chips or a similar snack; chocolate; lollies (candy); muesli or fruit bars; savory biscuits; sweet biscuits; ice cream; hot chips (french fries); pies, pasties, or sausage rolls; hot dogs; pizza **Method:** Index/Score Analysis	**Age at outcome: mean, 12.7 years (F/U 1 year)** **Results:** Non-core food score & Overweight/Obesity: Mean difference: -0.6, 95% CI: -1.7 to 0.5; p=0.26	• Did not account for: Anthropometry at baseline (within outcome), Physical Activity, SEP (although all bottom 2 SES strata) • Diet assessed twice from questionnaire; Outcomes objectively measured (BMI z-score via WHO); • Indirectly designed to examine obesity-related behaviors and change of school • Funding: Windermere Foundation

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Oellingrath, 2017 [22] PCS; Norway; N=393 **Selection/Participant data** • Income: both parents low 7%, one parent/mid 45%, both parents high 46%, missing 2%; • Education: 52% maternal education uni/college; 40% paternal education uni/college, missing 5%	**Age at dietary pattern: 12 to 13 years, mean 12.7** 'Junk Convenient': characterised by high-energy processed fast foods, refined grains, cakes and sweets **Method:** Factor/Cluster Analysis	**Age at outcome: F/U: 3 years** **Results:** 'Junk Convenient' (T1 ref) & risk of overweight at 10th grade: • If normal-Weight @ baseline: T2+T3, OR: 0.9, 95% CI: 0.4, 2.3 • If overweight at baseline: T2+T3, OR: 2.2, 95% CI: 0.6, 8.6	• Did not account for: Race/Ethnicity (Norwegian) • Diet assessed via FFQ (valid) at 7th and 10th grade; Outcomes objectively measured (BMI categories via IOTF); Dieatary pattern combined with physical activity reduced odds of overweight, but only in those already overweight • Funding: Research Council of Norway and the Public Health Programme for Telemark
Pala, 2013 [23] PCS; Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany, Spain Analytic N=9427 **Selection/Participant data** • 15% from Italy, 11% Estonia, 11% Cyprus, 12% Belgium, 12% Sweden, 13% Germany, 17% Hungary, 10% Spain • Excluded those with missing data	**Age at dietary pattern: 2 to 10 years** • **'Snacking':** Positive loadings for Hamburger, hot dog, kebab, falafel; Butter or margarine on bread, savory pastries, chocolate/candy bars, white bread; Negative: cooked vegetables • 'Sweet Fat': Positive loadings for chocolate or nut-based spreads; Cakes, puddings, cookies; Candy and sweets (no chocolate); fried meat; soft drinks with added sugar or diet; mayonnaise and similar; cured meat and sausages **Method:** Factor/Cluster Analysis	**Age at outcome: 4 to 12 years** **Results:** 'Snacking' T1, ref 1 • Overweight/Obesity, T2, OR: 1.09, 95% CI: 0.88, 1.35 • Overweight/Obesity, T3, OR: 1.18, 95% CI: 0.91, 1.52; p-trend=0.22 • Overweight/Obesity, per-unit, OR: 1.03, 95% CI: 0.97, 1.09 • ΔBMI T1, 0.73 • ΔBMI T2, 0.76; p=0.51 • ΔBMI T3, 0.78; p=0.35 • p-trend=0.36 'Sweet and fat' T1, ref 1 • Overweight/Obesity, T2, OR: 1.08, 95% CI: 0.88, 1.33 • Overweight/Obesity, T3, OR: 0.97, 95% CI: 0.77, 1.22; p-trend=0.74 • ΔBMI T1, 0.73 • ΔBMI T2, 0.76; p=0.55 • ΔBMI T3, 0.78; p=0.26 • p-trend=0.26	• Did not account for: Race/ethnicity (Country) • Diet assessed once at baseline; Water intake was imputed; • Did not account for missing data • Funding: European Community's Sixth RTD Framework Programme

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Saldanha-Gomes, 2017 [24] PCS; France Analytic N=883 **Selection/Participant data:** • French-birth-cohort • Household income: ~10% <1500/mo, ~12% > 3800; Maternal Education: ~20% < high-school, ~36-39% 3 year college degree • Excluded those with multiple pregnancy, diabetes history, French illiteracy, or with plans to move	**Age at dietary pattern: 2 years** 'Processed, fast foods': high freqency of French fries, processed meat, carbonated soft drinks, crisps, biscuits, pizzas, fruit juices, dairy puddings and ice cream, legumes, and bread; low in cooked vegetables **Method:** Factor/Cluster Analysis	**Age at outcome: 5 years** **Results:** • ♂ BMI -0.04, 95% CI: -0.11, 0.04; P=0.364 • ♀ BMI 0.08, 95% CI: -0.01, 0.17; P=0.099 • ♂ Body fat %, 0.02, 95% CI: -0.20, 0.25; P=0.829 • ♀ Body fat %, 0.19, 95% CI: -0.08, 0.46; P=0.176	• Did not account for: Race/Ethnicity • Diet assessed once via FFQ at age 2 years; Outcomes objectively measured (BMI z-score via IOTF); Complete-case analysis produced similar/consistent results as main findings; Cohort participants generally from higher SEP than rest of France • Funding: Foundation for Medical Research, National Agency for Research, National Institute for Research in Public Health*
Saldanha-Gomes, 2022 [25] PCS; France Analytic N=1138 **Selection/Participant data:** • French-birth-cohort • 24% 2y university degree; 39% ≥3y university degree • Excluded children who died, dropped out, 2 year questionnaire not returned, age at adiposity rebound not calculable	**Age at dietary pattern: 2 years** 'Processed, fast foods': high intakes of French fries, processed meat, carbonated soft drinks, crisps, biscuits, pizzas, fruit juices, dairy puddings and ice cream, legumes, and bread; low in cooked vegetables. **Method:** Factor/Cluster Analysis	**Age at outcome: 5.5 years, mean** **Results:** Early adiposity rebound (AR): • AR (♂ 3.8 years; ♀3.6 years): OR: 1.23, 95% CI: 1.00, 1.50; p=0.051 • AR cont. in days: β: -24, 95% CI: -55, 8); p=0.14	• Did not account for: Race/Ethnicity • Diet assessed once via FFQ at age 2 years; Outcomes objectively measured; Cohort participants generally from higher SEP than rest of France • Funding: Foundation for medical research, National Agency for Research, National Institute for Research in Public Health*

* Additional funding reported in Saldanha-Gomes et al. 2017 and 2022: French Ministry of Health, French Ministry of Research, INSERM Bone and Joint Disease National Research, Human Nutrition National Research Programs, Paris-Sud University, Nestle, French National Institute for Population Health Surveillance (InVS), French National Institute for Health Education (INPES), the European Union FP7 programmes, Diabetes National Research Program, French Agency for Environmental Health Safety, Mutuelle G´en´erale de l'Education Nationale, French national agency for food security, French-speaking association for the study of diabetes and metabolism

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Sirkka, 2021 [26] PCS; Netherlands Analytic N=938 **Selection/Participant data:** • Dutch-birth-cohort; • 28.6% low maternal education • Excluded those with incomplete dietary and covariate data; no BMI measurement age 3 to 10 years; LFU	**Age at dietary pattern: 3 years** UPF pattern characterized by: high intakes of white bread, crisps, savory snacks, and SSB; low intakes of whole-grain bread **Method:** Factor/Cluster Analysis	**Age at outcome: 10 years** **Results:** UPF & Risk of Overweight: OR: 1.30, 95% CI: 1.08, 1.57; p=0.006	• Did not account for: Physical activity • Diet assessed once via FFQ at age 3 years (validated in 4-6 years); Outcomes objectively measured (BMI z-score calculated and defined via WHO) • Funding: Unrestricted grant of Hutchison Whampoa Ltd., Hong Kong, and supported by the University of Groningen, Well Baby Clinic Foundation Icare, Noordlease, Paediatric Association Of The Netherlands, Youth Preventive Health Care Drenthe, and the European Union's
Smith, 2014 [27] PCS; United Kingdom Analytic N=3911 **Selection/Participant data:** • 97% 'White'; 3% 'Non-White'; UK birth-cohort • 18% maternal education post-high school • Excluded those with missing data; other reasons NR	**Age at dietary pattern: 9 years** **'Packed Lunch'**: Higher loadings for low-fiber bread, margarine, cheese, cold meats, salty flavorings such as yeast extract, diet squash (dilutable soft drink) **Method:** Factor/Cluster Analysis	**Age at outcome: 11 years** **Results:** SS, linear regression coefficient In valid reporters: Fat mass, • ♂ SS: 0.989, 95% CI: 0.976,1.002 • ♀ SS: 0.989, 95% CI: 0.978,1 Lean mass • ♂ SS: 1.003, 95% CI: 1.001,1.005 • ♀ SS: 1, 95% CI: 0.998,1.003 In under reporters: Fat mass • ♂ SS: 0.987, 95% CI: 0.968, 1.007 • ♀ SS: 1, 95% CI: 0.983,1.018 Lean mass • ♂ SS: 0.999, 95% CI: 0.996,1.002 • ♀ SS: 1.001, 95% CI: 0.996,1.005	• Did not account for: n/a (all accounted for) • Diet assessed once via 3-day diet diary (24 hour recall if diary missed); Outcomes objectively measured (DXA); • Diet assessments had unclear timing, validity, and reliability in relation to outcomes; Did not account for missing data • Funding: The UK Medical Research Council, the Wellcome Trust and the University of Bristol; World Cancer Research Fund

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Vedovato, 2021 [28] PCS; Portugal Analytic N=1175 **Selection/Participant data:** • Portuguese birth cohort • ~12 years, mean maternal education; 92% children live with both parents • Excluded those w/o 2-day food diaries; missing data; congenital anomalies or diseases that might influence dietary intake; twins	**Age at dietary pattern: 4 years; 7 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g. Soft drinks; sweet or savoury packaged snacks; ice cream, chocolate, candies; massproduced packaged breads and buns; margarines and spreads; cookies, pastries and cake mixes; breakfast cereals and cereal/energy bars; milk, cocoa and fruit drinks; meat and chicken extracts and instant sauces; infant formulas, follow-on milks and other baby products; ready-to-heat/eat products and dishes (pies, pasta, pizza, desserts); processed meats and sausages; packaged soups and noodles; flavoured and/or artificial sweetened yoghurt **Method:** Index/score	**Age at outcome: 10 years** **Results:** UPF & BMI z-score: • Age 4 years, β: 0.028, 95% CI: 0.006, 0.051 • Age 7 years, β: 0.014, 95% CI: -0.007, 0.036	• Did not account for: Race/Ethnicity (100% Portugese-birth cohort) • Diet assessed ≥twice with 2-day or 3-day food diaries at age 4 years and 7 years; Outcomes objectively measured (BMIz via WHO); • Data NR for sensitivity analyses by UPF in % TEI (only per 100 kcal) • Funding: Portuguese Ministry of Education and Science; Health Operational Programme; Community Support Framework III; Regional Department of Ministry of Health
Vilela, 2022 [29] PCS; Portugal Analytic N=3034 **Participant data:** • Portuguese birth cohort • maternal education, mean 11 years • Excluded those with missing diet/anthro data; twins; and those with congenital anomalies or diseases impacting food intake	**Age at dietary pattern: 7 years** UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g. Carbonated beverages, fruit-based beverages, other sugar-sweetened beverages; flavored and/or artificial sweetened yoghurt and milk based drinks; sweet or savory packaged snacks; ice-cream, chocolate, candies; mass-produced packaged breads, buns; margarines, spreads; ultra-processed cheeses; cookies, pastries, cake mixes; breakfast cereals, cereal/energy bars; milk/cocoa/fruit drinks; meat and chicken extracts, instant sauces; infant formulas, follow-on milks, other baby products; ready-to-heat/eat products and dishes (pies, pasta, pizza, desserts); processed meats, sausages; packaged soups, noodles; food supplements, artificial sweeteners.	**Age at outcome: 10 years** **Results:** UPF, Nova 4 • BMI z-score, β:−0.009, 95% CI: −0.029, 0.011 • Fat mass z-score, β:−0.006, 95% CI: −0.022, 0.011 • Fat free mass z-score, β:0.012, 95% CI: −0.005, 0.029 • Waist circumference z-score, β:−0.003, 95% CI: −0.019, 0.014 Nova 3 • BMI z-score, β:0.010, 95% CI: −0.040, 0.061 • Fat mass z-score, β:−0.002, 95% CI: −0.043, 0.040 • Fat free mass z-score, β:0.037, 95% CI: −0.005, 0.079	• Did not account for: Age, Race and/or Ethnicity (Portuguese birth-cohort) • Diet assessed once with 3-day food diaries at age 7 years; Outcomes objectively measured • Funding: FEDER via the Operational Programme Factors of Competitiveness; Foundation for Science and Technology; Unidade de Investigaç~ao em Epidemiologia - Instituto de Saúde Pública da Universidade do Porto (EPIUnit); the Laboratorio para a Inve

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
	Nova 3: Canned or bottled vegetables, fruits, legumes; salted or sugared nuts, seeds; salted, cured, or smoked meats (e.g., bacon, typical Portuguese sausages); canned fish; fruits in syrup; cheeses, unpackaged freshly made bread; plain yoghurt with added sugar. Nova 2 + 1: Butter and lard, vegetable oil, vinegar, honey, table sugar (honey, molasses, syrups) and salt + Fresh, chilled, frozen, dried, vacuum-packed fruits, vegetables, fungi, tubers, roots, grains, legumes; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry and seafood; eggs; fresh and pasteurized milk, plain yoghurt with no added sugar or food additives added; 100% unsweetened fruit juices and smoothies; coffee; tea; water. **Method:** Index/Score Analysis	• Waist circumference z-score, β:0.005, 95% CI: −0.037, 0.046 Nova 2+1 • BMI z-score, β:−0.028, 95% CI: −0.043; −0.014 • Fat mass z-score, β:−0.023, 95% CI: −0.035; −0.011 • Fat free mass z-score, β: 0.002, 95% CI: −0.010, 0.014 • Waist circumference z-score, β:−0.020, 95% CI: −0.032; −0.008	

Wolters, 2018 [30]
PCS; Germany
N=312 Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS (IDEFICS);
N=372 the Kiel Obesity Prevention Study (KOPS)
 	
Participant data:
• Low-income, 8% KOPS, 17% IDEFICS;
• Parent Education at least 12y: 58% KOPS, 50% IDEFICS
	Age at dietary pattern: 5 to 7 years KOPS; 2 to 9.9 years IDEFICS
	• KOPS PCA 1 'Fast food': High loadings for fish sticks, curry-sausage, lasagna, pancakes, potato fritters, pizza, meatballs
	• KOPS ∆PCA1: Increased meatballs, fish sticks, lasagna, pizza, pancakes, curry-sausage, potato fritters
	• IDEFICS PCA 1 'Snack': High loadings for sweet snacks, potatoes; ketchup etc.; savory snacks; sweetened drinks; chocolate, candy bars; candies, ice cream/milk/fruit-bars
	• IDEFICS ∆PCA3 twd PCA1:
		Age at oucome: 9 to 11 years (KOPS); 4 to 11.9 years (IDEFICS)
		
		Results: T1, OR: 1 ref
		BMI
		• KOPS-PCA1
		  ○ T2, OR: 0.81, 95% CI: 0.44, 1.49
		  ○ T3, OR: 1, 95% CI: 0.55, 1.80
		  ○ Cont., OR: 1.01, 95% CI: 0.95, 1.07
		  ○ p=0.8457
		• KOPS ΔPCA 1
		  ○ T2, OR: 0.95, 95% CI: 0.51, 1.75
		  ○ T3, OR: 1.49, 95% CI: 0.83, 2.68
		  ○ Cont., OR: 1.05, 95% CI: 0.99, 1.10
		  ○ p=0.1133
		• IDEFICS, PCA1
			• Did not account for: Race/Ethnicity (adjusted for migration in IDEFICS)
			• Diet change assessed via FFQ (different in KOPS and IDEFICS) at beginning and end of primary school periods
			• Outcomes objectively measured in both cohorts (BMI via IOTF)
			• Funding: Federal Ministry of Education and Research; Open Access Fund of the Leibniz Association; Additional funding for KOPS and IDEFICS studies separate

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
	Increased sweet snacks, candies, ice cream/milk/fruit-bars, savory snacks; chocolate, candy bars **Method:** Factor/cluster analysis	○ T2, OR: 0.67, 95% CI: 0.35, 1.26 ○ T3, OR: 0.47, 95% CI: 0.23, 0.91 ○ Cont., OR: 0.94, 95% CI: 0.87, 1.01 ○ p=0.081 • IDEFICS, ΔPCA 3 ○ T2, OR: 1.6, 95% CI: 0.83, 3.15 ○ T3, OR: 1.46, 95% CI: 0.75, 2.87 ○ Cont., OR: 1.02, 95% CI: 0.94, 1.11 ○ p=0.6363 Fat mass index • KOPS-PCA1 ○ T2, OR: 0.67, 95% CI: 0.37, 1.24 ○ T3, OR: 0.73, 95% CI: 0.41, 1.33 ○ Cont., OR: 0.99, 95% CI: 0.94, 1.06 ○ p=0.8556 • KOPS-ΔPCA 1 ○ T2, OR: 1.19, 95% CI: 0.64, 2.21 ○ T3, OR: 1.86, 95% CI: 1.03, 3.38 ○ Cont., OR: 1.06, 95% CI: 1.00, 1.12 ○ p=0.0411 • IDEFICS, PCA1 ○ T2, OR: 1.06, 95% CI: 0.55, 2.03 ○ T3, OR: 0.78, 95% CI: 0.39, 1.52 ○ Cont., OR: 0.98, 95% CI: 0.91, 1.05 ○ p=0.6013 • IDEFICS, ΔPCA3 ○ T2, OR: 1.27, 95% CI: 0.65, 2.50 ○ T3, OR: 1.49, 95% CI: 0.78, 2.90 ○ Cont., OR: 0.99, 95% CI: 0.91, 1.08 ○ p=0.8546 Waist-hip ratio • KOPS-PCA1 ○ T2, OR: 0.54, 95% CI: 0.29, 1.01 ○ T3, OR: 0.88, 95% CI: 0.49, 1.57	

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
		○ Cont., OR: 1, 95% CI: 0.95, 1.06; p=0.9329 • KOPS-ΔPCA 1 ○ T2, OR: 0.79, 95% CI: 0.43, 1.46 ○ T3, OR: 1.35, 95% CI: 0.76, 2.40 ○ Cont., OR: 1.02, 95% CI: 0.97, 1.08 ○ p=0.3665 • IDEFICS, ΔPCA3 ○ T2, OR: 1.17, 95% CI: 0.59, 2.33 ○ T3, OR: 1.64, 95% CI: 0.86, 3.19 ○ Cont., OR: 1.03, 95% CI: 0.95, 1.12 ○ p=0.4342	

[a] Abbreviations: DXA, Dual-energy X-ray absorptiometry; FFQ, Food frequency questionnaire; F/U, Follow-up; IOTF, International Obesity Task Force; LFU, lost to follow-up; NR, not reported; OR, odds ratio; Q, quantile; SEP/SES, Socioeconomic position/status; T, tertile; T2D, Type 2 Diabetes; UPF, Ultra-processed food; WHO, World Health Organization; ♂ male; ♀ female

Table 10. Risk of bias for observational studies examining dietary patterns with varying amounts of ultra-processed food consumed by children and adolescents and growth, body composition and risk of obesity[a]

Article	Confounding	Exposure classification	Participant Selection	Post-exposure interventions	Missing data	Outcome measurement	Selection of the reported result	Overall
Arruda, 2021 [6]	Low	Some concerns	Low	Low	High	Low	Low	Some concerns
Bawaked, 2020 [7]	High	Low	Some concerns	Low	Low	Low	Some concerns	High
Biazzi, 2017[8]	Some concerns	Low	Some concerns	Low	Some concerns	Low	Some concerns	High
Chang, 2021[9]	Low	Some concerns	Some concerns	Low	Some concerns	Low	Some concerns	Some concerns
Costa, 2019[10]	High	Low	Some concerns	Low	Low	Low	Some concerns	High
Costa, 2021[11]	Some concerns	High	Low	Low	Low	Low	Low	High
Costa, 2022[12]	Some concerns	High	Low	Low	Low	Some concerns	Some concerns	High
Cunha, 2018[13]	High	High	Some concerns	Low	Low	Low	Low	High
Durao, 2017[14]	Some concerns	Some concerns	Low	Low	High	Low	Some concerns	High
Durão, 2022[15]	Some concerns	Some concerns	Some concerns	Low	Some concerns	Low	Some concerns	High
Gasser, 2019[16]	Low	Some concerns	Low	Low	Some concerns	Low	Some concerns	Some concerns
González, 2023[17]	Some concerns	Very High	Low	Low	Low	Low	High	Very High
Heerman, 2023[18]	High	Some concerns	High	Low	Low	Low	Some concerns	High
Hennessy, 2023[19]	High	High	Some concerns	Low	High	Low	Some concerns	High
Marinho, 2022[20]	Very High	Some concerns	Low	Low	Low	Low	High	Very high
Marks, 2015[21]	High	High	High	Low	Some concerns	Low	Low	High
Oellingrath, 2017[22]	Some concerns	Low	Some concerns	Low	High	Some concerns	Some concerns	High
Pala, 2013[23]	Some concerns	Low	Low	Low	High	Low	Some concerns	High
Saldanha-Gomes, 2017[24]	Some concerns	Some concerns	Low	Low	Low	Low	Low	Some concerns
Saldanha-Gomes, 2022[25]	Some concerns	High	Low	Low	Some concerns	Low	Low	High
Sirkka, 2021[26]	High	Some concerns	Some concerns	Low	High	Low	Low	High
Smith, 2014[27]	Low	Low	Some concerns	Low	Very High	Low	Some concerns	Very High
Vedovato, 2021[28]	Low	Some concerns	Low	Low	Some concerns	Low	Some concerns	Some concerns
Vilela, 2022[29]	Low	Low	Some concerns	Low	Low	Low	Some concerns	Some concerns
Wolters, 2018[30]	Some concerns	Low	Low	Low	High	Low	Low	High

[a] Possible ratings of low, some concerns, high, very high, not applicable, or no information determined using the "Risk of Bias in Non-randomized Studies of Exposures (ROBINS-E)" tool (ROBINS-E Development Group,Higgins J, Morgan R, Rooney A et al. Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E). Launch version, 1 June 2022. Available from: https://www.riskofbias.info/welcome/robins-e-tool.) *Low risk of bias except for concerns about uncontrolled confounding.

Adults and older adults

Sixteen articles met inclusion criteria that examined the relationship between dietary patterns with varying amounts of UPF consumed by adults and older adults and body composition and risk of obesity (also see Table 8). One article came from an RCT[32] and 15 came from prospective cohort studies.[31,33-46]

Description of the evidence

Population

Studies were conducted in the following countries: Australia; Brazil (n=4); China; France; Iran; Korea; Spain (n=4); and the United Kingdom (n=2). One study was conducted across multiple countries (Denmark, France, Germany, Greece, Italy, Netherlands, Norway, Spain, Sweden, and the United Kingdom). Two included articles were based on data from the same cohort study but examined dietary patterns differently (e.g., per 100g vs. per 100 kcal increase). Studies ranged in sample size from 661 participants to 348,748 participants.

In 9 articles, the mean BMI of the study population was ≥ 25 kg/m2 (i.e., participants with overweight or obesity) or were at high-risk for diet-related chronic disease. Socioeconomic position of participants was reported most commonly from educational attainment level of participants, which was relatively high (e.g., >50% of participants had ~ 12 years or more) in 9 articles but widely varied in other articles. Race and/or ethnic information about participants was reported in 8 of 17 articles as follows:

- "16.2% Black; Brown, 28.1%; 52.2% White; 2.6% Asian, 1% Indigenous" [33]
- "14% Black, 27% Brown, 55% White, 3% Asian, 1% Indigenous" [34]
- "6% "Black", 31% "Brown", 62% "White", 1% "Yellow/Oriental" [44]
- "White, Spanish" [37]
- "White British" [39]
- 100% Caucasian [32]
- "Brazilian" [45]
- "Korean" [46]

Studies examined dietary patterns consumed by participants ranging in age between 18 up to 75 years. Mean follow-up duration varied widely across studies, with a range from 6 months to approximately 15 years.

Intervention/exposure and comparator

Dietary intake assessment methods included food-frequency questionnaire,[32,33-37,40-42,44,46] and 24-hour recalls.[31,38,39,43,45] Dietary pattern methods included reduced rank regression,[39] factor/cluster analysis[32] and a priori score derivation in the remaining studies that used the Nova[*] classification to define UPF intake. In the one article from an RCT,[32] dietary pattern changes were examined by factor analysis 6 months after participants followed the investigator-assigned "Atlantic" diet, which was intended to reflect traditional patterns in northwestern Spain and Portugal (composed of home-cooked, local, fresh, and minimally processed foods).

Intake of UPF was analyzed as a continuous exposure variable (e.g., per 10% or 15% different in energy from UPF,[31,33,36,37,41,43] per standard deviation,[35] or by weight;[34,38,44,46]) and/or categorically (e.g., 700 vs. 234 g/d, g/day, servings/day, and/or quantiles).[31,33,35-38,40-46]All included studies described the types of UPF contributing to the dietary pattern, but the number and types of UPF items and/or sub-groups within dietary patterns varied (e.g., 14 total items; 6 main sources; 3 sub-groups with 23 total items).

[*] Details about the Nova food classification system can be found in this publication: Monteiro CA, Cannon G, Levy RB, et al. Ultra-processed foods: what they are and how to identify them. Public Health Nutr. 2019;22(5):936-941. doi:10.1017/S1368980018003762

Outcomes

Included articles reported standardized procedures to measure body size and/or composition measurements in-person or used self-reported measures of weight and height. The following outcomes were reported across the body of evidence:

- Risk of overweight and/or obesity[40,46]
- BMI[31,36,43-46]
- Body composition (such as fat mass, fat mass index, % body fat)[37,39,43,44]
- Waist circumference[33,34,36,38,39,43]
- Weight [33,35,36]

Synthesis of the evidence

This evidence synthesis focuses on the studies with fewer limitations, which included 1) studies that were designed to directly examine dietary patterns that vary in UPF, 2) studies that used 24-hour recall to collect dietary intake of UPF, and 3) studies that used a food processing classification system to categorize items as UPF. Across evidence, the direction of reported effect estimates were similar, regardless of statistical significance, and suggested that dietary patterns with higher compared to lower amounts of foods classified as UPF were significantly associated with higher risks of developing overweight and/or obesity, larger waist circumference, greater adiposity (e.g., fat mass, fat mass index, % body fat), and/or higher BMI.[31-38,40,41,43-46] In 2 of these 14 articles, dietary patterns with few or no foods classified as UPF were significantly associated with lower risks of developing obesity and/or less BMI gain.[45,46]

The mean amount of UPF within dietary patterns ranged from ~5% up to 74% of total energy consumed in the populations for studies reporting this information. Common sources or types of UPF contributing to the dietary patterns included:

- sources of added sugar, primarily from refined grains and/or sugar-sweetened foods (e.g., mass-produced/packaged cookies, breads, buns, rolls, cakes, pastry)[31,33-46]
- processed meats and meat products (e.g., ham, sausage, hot dog, nuggets)[31-38,40-42,44-46]
- sugar-sweetened beverages (e.g., soft drinks, sports drinks, fruit drinks)[31-38,40-42,44-46]
- packaged (salty or savory) snack foods (e.g., chips, crackers),[31-34,36-38,41-45]
- pre-prepared, “fast”, ready-to-eat meals and dishes (e.g., pizza, instant noodles)[32-39,41-46]

Two of 16 articles reported a consistent direction of findings, but did not observe statistically significant associations between dietary patterns with varying amounts of UPF and risk of obesity and/or BMI.[39,42] One of these articles used Nova 4 to classify UPF intake, and the other used reduced rank regression to examine a dietary pattern of foods typically classified as UPF (e.g., confectionary; buns, cakes, and pastries; sugar-sweetened soft drinks, processed meats). Therefore, the lack of statistical significance may be explained by these methodological inconsistencies.

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question based on their review of evidence that examined dietary patterns with foods classified as UPF consumed by adults and older adults in relation to outcomes including risk of obesity, overweight, and/or adiposity (fat mass, waist circumference, BMI) (Table 11).

Table 11. Conclusion statement, grades for dietary patterns with varying amounts of ultra-processed food consumed by adults and older adults and body composition, and risk of obesity.

Conclusion Statement	**Dietary patterns consumed by adults and older adults with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of obesity and/or overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)**
Grade	Limited
Body of Evidence	16 articles: 1 RCT, 15 articles from prospective cohort studies
Consistency	The body of evidence was consistent in magnitude and direction of effect estimates
Precision	Few concerns with narrow variance around effect estimates
Risk of bias	Serious concerns due to potential confounding, exposure misclassification, and not accounting for missing data
Directness	Some concerns that not all dietary patterns compared were directly varying in UPF
Generalizability	Participant characteristics, dietary patterns, and outcomes likely generalize but there were serious concerns with applicability of UPF to the U.S. population given the inconsistencies in amounts and types of UPF available in the countries and time periods included in the studies.

Assessment of Evidence

As described below, the body of evidence was assessed for the following elements used when grading the strength of evidence. This body of evidence includes both large and small studies, including studies with smaller sample sizes and null findings, which makes publication bias less likely.

Consistency:

Direction and magnitude of effects were consistent in ~ 88% (16) of the studies: dietary patterns with higher compared to lower UPF were significantly associated with higher risk of overweight, greater BMI, waist circumference, and/or fat mass. Two studies also analyzed dietary patterns that were definitively low in UPF and observed they were related to a lower risk of obesity/overweight, and/or less gain in BMI or weight. For the 2 studies that did not report statistically significant findings, the direction of the relationship was similar to the other studies, supporting a positive association between dietary patterns with varying amounts of UPF and these health outcomes.

Precision:

The studies were generally well-powered to address the research question and demonstrated effects from a wide range of sample sizes (n=661 to 348,748).

Risk of bias (Table 7 and Table 8)

Across domains, various risks of bias were identified. Most of the key confounders were accounted for across studies with few exceptions: race and/or ethnicity of participants was not reported or accounted for in 8 articles and anthropometry at baseline in 3 articles. Nine of the studies assessed diet only once (at baseline), and therefore do not fully account for potential change in dietary patterns that may have occurred over time. Assessment of foods and beverages as UPF based on dietary intakes collected via food-frequency questionnaires contributes to potential for exposure misclassification. Most studies objectively measured outcomes, but 6 used self-reported weight/height.

Directness:

Studies were directly addressing the relationship of interest by examining dietary patterns with varying amounts of UPF, which were based on the Nova classification system in most studies. A few studies examined dietary patterns comprised of foods that are typically classified as “UPF” or likely consumed in ultra-processed versions but were not explicitly designated or cited as such with a specific classification system.

Generalizability:

No studies were conducted in the U.S. Nine articles included a majority or all participants with overweight/obesity and/or high-risk for diet-related chronic disease. Nine studies did not report information on the racial or ethnic background of participants. Education was the most common information provided on SEP of participants and varied across studies. Most of the dietary patterns compared are generalizable to the U.S. population. However, a few sources of UPF (from select studies) may not be as generalizable (e.g., ‘acarajé’ or ‘instant pork mince dumpling’). The outcomes examined are generalizable to the U.S. population.

Table 12. Studies examining the relationship between dietary patterns with varying amounts of ultra-processed food consumed in adults and older adults and growth, body composition and composition and risk of obesity[a]

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Beslay, 2020 [31] France; NutriNet-Sante Analytic N=110,260; 71871 Obesity; 55037 Overweight **Participant Characteristic:** • Health status: Mean BMI: 23.8 • Race and/or ethnicity: NR • SEP info: Education (baseline): < high shcool: 18%; <2 y post-high-school: 17%; ≥2 y post-high-school: 65% **Selection data:** Excluded those with overweight or obesity at baseline, missing/extreme data, <2 dietary records and anthrompometric questionnaires, or < 6 months follow-up	**Age at dietary pattern:** 18 to 73.3 years (mean 43.1 [14.6]) UPF (Nova food classification system, group 4 [Monteiro, 2019]) 8 sub-groups: Fruits and Vegetables (UPF, reconstituted); Starchy foods and breakfast cereals (Industrial/flavored with additives); Meat, fish and egg (Processed/Industrial with additives); Dairy products (flavored or artificially sweetened; with additives); Beverages (sugary drinks, energy drinks, artificially sweetened); Sugary products (industrial cookies, cakes, candies with additives); Fats and sauces (dressing, mayonnaise, ketchup, other with additives); Salty snacks (chips, crisps, crackers with additives e.g., oil, salt, maltodextrin, flavors). **Method**: Index/Score Analysis	**Follow-up duration (F/U): 5 years, median** UPF & Risk of Overweight (model 3) • per 10%, HR: 1.10, 95% CI: 1.08, 1.13, p<0.001 • Q2, HR: 1.06, 95% CI: 0.99, 1.13 • Q3, HR: 1.18, 95% CI: 1.10, 1.26 • Q4, HR: 1.24, 95% CI: 1.16, 1.33; p-trend<0.001 UPF & Risk of Obesity (model 3) • per 10%, HR: 1.10, 95% CI: 1.06, 1.14, p<0.001 • Q2, HR: 1.05, 95% CI: 0.95, 1.17 • Q3, HR: 1.11, 95% CI: 1.00, 1.23 • Q4, HR: 1.16, 95% CI: 1.05, 1.30; p-trend=0.003 UPF & BMI Δ (model 2) • per 10%, β 0.02, 95% CI: 0.01 to 0.02, p<0.001 • Q2, β 0.01, 95% CI: 0.004 to 0.02 • Q3, β 0.01, 95% CI: 0.01 to 0.02 • Q4, β 0.04, 95% CI: 0.04 to 0.05; p-trend<0.001	• Did not account for: Race/Ethnicity • Self-reported Weight, Height; Diet assessed once with 24 hour recall at baseline only **Funding**: Ministère de la Sante´, Sante´ Publique France, Institut National de la Sante´ et de la Recherche Me´dicale, Institut National de la Recherche Agronomique, Conservatoire National des Arts et Me´tiers, and Universite´ Sorbonne Paris Nord

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Calvo-Malvar, 2021 A [32] Spain; Galiat study Analytic N=661 **Participant Characteristic:** • Health status: CVD, 16-18%; DM, 6% • Race and/or ethnicity: 100% Caucasian • SEP: Employed ~48-52%; Retired ~14-20%; Other ~32-34%; Education: None, ~10%; Elementary, 36-42%; Secondary 32-36%; Uni+ 16-18% **Selection data:** Excluded those with alcoholism, pregnancy, major CVD, dementia, predicted survival <1 y; on lipid-lowering medication. Analyses include intention-to-treat (ITT) with imputed data for missing values, and per-protocol (PP) including only those with complete data	**Dietary patterns at age(s)**:~ 3 to 85 years "Caloric" dietary pattern: Positive: high-energy drinks, processed meats, precooked food, pizza, salty snacks, mayonnaise and ketchup, sweets. Negative: wine **Method**: RCT: Factor/Cluster	**F/U: 6 months** 'Caloric' dietary pattern and • Δ Weight (ITT), β: 0.146, -0.030, 0.332; p-trend=0.103 • Δ Weight (PP), β: 0.172, 95% CI: 0.002, 0.343; p-trend=0.047	• Did not account for: Race/Ethnicity • Included a random representative sample drawn from Spanish National health System Register (ages 18-85) and relatives who shared a home (ages 3-85) in family unit ≥ 2 members **Funding**: ERDF-Innterconecta for Galicia Program

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Canhada, 2019 [33] Brazil; ELSA-Brasil Analytic N=11827 (Wt; WC); 4525 OW/Ob; 4771 Ob **Participant Characteristic:** • Health status: Excluded those with chronic diseases at baseline; Mean BMI, 26.8, WC, cm, 90.6 • Race and/or ethnicity: Black, 16.2%; Brown, 28.1%; White, 52.2%; Asian, 2.6%; Indigenous, 1% • SEP info: Median family income, 5x Brazilian minimum wage; Education: < elementary, 5%; Elementray, 6%; Secondary, 35%; College/University, 54% **Selection data:** All Civil servants of Brazilian public academic institutions; Excluded those with no FFQ data, missing data on weight, WC or covariates, and implausible intake, chronic disease, on meds influencing consumption; LFU, or had bariatric surgery between visits.	**Age at dietary pattern:** 35 to 75 years, mean 51 years at baseline UPF (Nova food classification system, group 4 [Monteiro, 2019]) 13 sub-groups: Bread; Sweets, candies; Sweetened sodas/juices; Salty pastries, chips; Cakes; Processed meat; Pasta and pizzas; Cookies, crackers; Mayonnaise, margarine, cream cheese; Yogurt with additives; Cereal bars; Distilled alcoholic beverages; Soup **Method**: Index/Score Analysis	**F/U: 3.8 years, mean** UPF & Risk of Overweight/Obesity, n=4527 • Q2, RR: 1.14, 95% CI: 0.98,1.33 • Q3, RR: 1.36, 95% CI: 1.18,1.57 • Q4, RR: 1.2, 95% CI: 1.03,1.4 UPF & Risk of Obesity, n=4771 • per 15%, 1.06, 95% CI: 0.96,1.17 • Q2, RR: 1.12, 95% CI: 0.95,1.32 • Q3, RR: 1.01, 95% CI: 0.85,1.21 • Q4, RR: 1.02, 95% CI: 0.85,1.21 UPF & WC, incident large gain • per-15%, 1.15, 95% CI: 1.06,1.25 • Q2, RR: 1.11, 95% CI: 0.94,1.33 • Q3, RR: 1.23, 95% CI: 1.04,1.46 • Q4, RR: 1.33, 95% CI: 1.12,1.58 UPF & Weight, incident large gain • per-15%, 1.12, 95% CI: 1.03,1.22 • Q2, RR: 1.15, 95% CI: 0.97,1.37 • Q3, RR: 1.2, 95% CI: 1.02,1.42 • Q4, RR: 1.27, 95% CI: 1.07,1.5 *Stronger association observed in non-Whites than other race/skin colour groups	• Did not account for: TEI • Diet assessed once at baseline only with validated FFQ; FFQ was not designed for UPF via NOVA classification; additional analyses: adjusted further for TEI, Fruit and Vegetable intake, excluding sweetened beverages; and tested interactions between sex, race/color, and age **Funding**: Brazilian Ministry of Health (Department of Science and Technology) and Ministry of Science, Technology and Innovation; National Council for Scientific and Technological Development

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Canhada, 2023 [34] Brazil; ELSA-Brasil Analytic N=8065 **Participant Characteristic:** • Health status: 62% never smokers • Race and/or ethnicity: "14% Black, 27% Brown, 55% White, 3% Asian, 1% Indigenous" • SEP info: Education: 59% college degree; Income: 747-2352 Brazilian reais (P25-P75) **Selection data:** Excluded those w MetS at baseline, LFU, missing/implausible diet or anthropometric data; Included active or retired employees of research/education institutions who were not pregnant	**Age at dietary pattern:** 49 years, median UPF (Nova food classification system, group 4 [Monteiro, 2019]) e.g., packaged products such as bread (light, toasted, sweet, whole grain), cheese bread, simple cake, stuffed cake, salty biscuit, sweet biscuit with filling, sweet biscuit without filling, light mayonnaise, mayonnaise, light sweetened yogurt, sweetened yogurt, light cream cheese, cream cheese, margarine/vegetable cream, sausage, hamburger (steak), sliced turkey breast, ham/mortadella/ salami, ready-packaged pizza, instant noodles, baked snacks, fried snacks, afro-Brazilian bean fritter (acarajé), hot dogs, instant soup, creamy ice cream, fruit popsicle, caramel/candy, gelatin, chocolate powder, chocolate bar, pudding, fruit jam/jelly, cereal bar, diet soda, soda, industrialized juice with sugar, industrialized juice without sugar, industrialized juice with sweetener, artificial juice with sugar, artificial juice without sugar, artificial juice with sweetener, distilled alcoholic beverages **Method**: Index/Score Analysis	**Results at F/U:~ 2 and 8 years** UPF 700 vs. 234 g/d & WC: 0.7cm, p=0.003	• Did not account for: N/A (all accounted for) • Diet assessed once via FFQ at baseline; Misclassification possible due to UPF intake based on FFQ; Outcomes objectively measured; Indirect outcome of Metabolic Syndrome **Funding**: Brazilian Ministry of Health (Department of Science and Technology) and Ministry of Science, Technology, and Innovation; National Council for Scientific and Technological Development

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Cordova, 2021 [35] Denmark, France, Germany, Greece, Italy, the Netherlands, Norway, Spain, Sweden, and the United Kingdom; EPIC Analytic N=348748 **Participant Characteristic:** • Health status: BMI <25 48-59%; Overweight 31-38%; Obesity 10-14%; • Previous illness, T2D, CVD, cancer: 7-8% • Race and/or ethnicity: NR • SEP info: University degree: Q1, 23%; Q2, 24%; Q3, 26%; Q4, 37%; Q5, 25% **Selection data:** Excluded those who were pregnant at baseline, or missing data on diet, lifestyle, or follow-up, reported extreme energy intake or unreliable anthropometric data	**Age at dietary pattern:** 25 to 70 years UPF (Nova food classification system, group 4 [Monteiro, 2019]) w/o alcoholic drinks: e.g., Vegetables and legumes in ultra-processed medium; Potato products; Breads (UPF); Pastries, buns, and cakes; Biscuits; Breakfast cereals; Pizza and focaccia (dough); Pasta (filled); Processed meat (beef, pork and fish); Meat alternatives; Dairy substitute products; Processed cheese; Dairy desserts and drinks (UPF version); Ice cream, ice pops and frozen yogurts; Industrial desserts; Fruit drinks, iced tea and other sweetened beverages; Beverages dry weight; Artificial sweeteners; Sweet snacks; Soft drinks; Packaged salty snacks; Instant and canned soups; ; Margarine; Vegetable spread and products; Alcohol-free versions of alcoholic beverages; Other: Ready meals; Nutrition powders and drinks; Sauces, dressing and gravies Nova 4 Q5 v. Q1 had similar Mediterranean diet scores but higher (not statistically) in intakes from: Dairy; Sugar/confectionary; Cakes/biscuits; Soft drinks; Lower in: Fruit; Legumes; Meat/meat products; Fish; Cereals; Alcoholic drinks; Similar Vegetables; Egg; Potatoes; Added Fat; Coffee **Method**: Index/Score Analysis	**F/U: 5 years, median** UPF & Weight gain • per SD, β: 0.118, 95% CI: 0.085, 0.151 • Q1, β: 1, ref • Q2, β: −0.009, 95% CI: −0.095, 0.076 • Q3, β: 0.101, 95% CI: −0.002, 0.205 • Q4, β: 0.193, 95% CI: 0.105, 0.282 • Q5, β: 0.352, 95% CI: 0.262, 0.442 • p-trend<0.001	• Did not account for: Race/Ethnicity • Diet assessed once with FFQs, validated but differed between cohort waves; Outcomes at baseline were measured in some countries and self-reported in others; • Residual method was used for energy adjustment; Conducted repeat analyses substituting NOVA 1 for NOVA 4; Conducted a range of sensitivity tests (Soft drinks as driver; by Sex, by Age, by BMI) **Funding**: Fondation de France[*]

[*]Cordova, 2021 additional funding: National cohorts supported by individual funders: Ligue Contre le Cancer, Institut Gustave-Roussy, Mutuelle Générale de l'Education Nationale, Institut National de la Santé et de la Recherche Médicale (INSERM) (France); German Cancer Aid, German Cancer Research Center (DKFZ), Federal Ministry of Education and Research (BMBF) (Germany); Associazione Italiana per la Ricerca sul Cancro-AIRC-Italy and National Research Council (Italy); Dutch Ministry of Public Health,Welfare and Sports (VWS), Netherlands Cancer Registry (NKR), LK Research Funds, Dutch Prevention Funds, Dutch ZON (Zorg Onderzoek Nederland),World Cancer Research Fund (WCRF), Statistics Netherlands (The Netherlands); Health Research Fund (FIS-ISCIII), the Regional Governments of Andalucía, Asturias, Basque Country, Murcia, Navarra, and the Catalan Institute of Oncology (Barceloan), Spain); Cancer Research UK and Medical Research Council (EPIC-Norfolk; EPIC-Oxford)

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
González-Palacios, 2023 [36] Spain; PREDIMED (Subset) Analytic N=5373 **Participant Characteristic:** • Health status: 100% high-cardiometabolic risk; 100% Overweight or Obesity; 30% T2D; 45% never smokers • Race and/or ethnicity: NR • SEP info: Education: 21% College; 29% secondary; Employment: 19% current; 58% retired; 77% maried **Selection data:** All participants were at high-CMR (3+ criteria for Metabolic Syndrome)	**Dietary patterns at age(s)**: 55 to 75 years UPF (Nova food classification system, group 4 [Monteiro, 2019]) 6 sub-groups: 1) Dairy products (Flavored milk drinks; Petit-suise; cheese portions or cream cheese; custard, pudding or similar and Ice cream); 2) Processed meats (Ham; Processed meats such as dried sausage, chorizo or similar; patés and foie gras; burgers and meatballs); 3) Sweets (Plain, whole grain and chocolate biscuits; croissants, pastries or similar; doughnuts; muffins; Spanish churros or similar; pies; chocolates and chocolate; cocoa powder; Spanish nougat; marzipan or similar); 4) Fast-foods (Crisps; pizza, croquettes, packet or canned soups, margarine, commercial mayonnaise, mustard, ketchup, packed fried tomato sauce, savory packed snacks); 5) Beverages (Soft drinks (sugar- and artificially-sweetened) and commercial fruit juices); 6) Alcoholic Beverages (Liquors and spirits (whisky vodka, gin and cognac) All Nova 4 items from FFQ: Flavored milk drinks; Petit-suise; Cheese portions or cream cheese; Custard, pudding or similar; Ice cream; Ham; Processed meats such as dried sausage, chorizo or similar; Patés and foie gras; Burgers and, meatballs; Crisps; Breakfast cereals; Pizza; Margarine; Plain biscuits; Whole grain biscuits; Chocolate biscuits; Croissants, pastries or similar; Doughnuts; Muffins; Spanish churros or similar; Pies; Chocolates and chocolate; Cocoa powder; Spanish nougat; Marzipan or similar; Croquetas, fishcakes, pasties, or similar; Packet or canned soups; Mustard;	**F/U: 6-12 months** UPF, g/d (Q1, ref) BMI, kg/m2 • Q2, β: 0.18, 95% CI: 0.12; 0.23 • Q3, β: 0.30, 95% CI: 0.24; 0.36 • Q4, β: 0.39, 95% CI: 0.33; 0.46; p <0.0001 • per 100g, β: 0.08, 95% CI: 0.06; 0.09; p <0.0001 WC, cm • Q2, β: 0.41, 95% CI: 0.22; 0.59 • Q3, β: 0.78, 95% CI: 0.58; 0.99 • Q4, β: 1.03, 95% CI: 0.81; 1.26; p<0.0001 • per 100g, β: 0.18, 95% CI: 0.11; 0.24; p <0.0001 Weight, kg • Q2, β: 0.50, 95% CI: 0.36; 0.63 • Q3, β: 0.83, 95% CI: 0.67; 0.98 • Q4, β: 1.09, 95% CI: 0.91; 1.26; p <0.0001 • per 100g, β: 0.21, 95% CI: 0.17; 0.26; p <0.0001 UPF, % TEI (Q1, ref) BMI, kg/m2 • Q2, β: 0.16, 95% CI: 0.11; 0.21 • Q3, β: 0.27, 95% CI: 0.21; 0.33 • Q4, β: 0.40, 95% CI: 0.33; 0.46; p <0.0001 • per 10%, β: 0.18, 95% CI: 0.13; 0.22; p <0.0001 WC, cm Q2, β: 0.32, 95% CI: 0.14; 0.51 • Q3, β: 0.68, 95% CI: 0.48; 0.89 • Q4, β: 0.96, 95% CI: 0.73; 1.18; p<0.0001 • per 10%, β: 0.44, 95% CI: 0.29; 0.59; p <0.0001 Weight, kg • Q2, β: 0.46, 95% CI: 0.32; 0.59 • Q3, β: 0.73, 95% CI: 0.58; 0.88 • Q4, β: 1.06, 95% CI: 0.89; 1.23; p <0.0001 • per 10%, β: 0.48, 95% CI: 0.36; 0.60; p	• Did not account for: Race/Ethnicity (Spanish), Anthropometry at baseline (100% Overweight/Obesity but Q4 UPF had higher baseline weight/WC/BMI) • Diet assessed with FFQ at baseline, 6 and 12 months; Misclassification possible due to UPF intake based on FFQ; All participants reduced UPF consumption of 6 sub-groups from baseline to 6 months and to 12 months (co-intervention effects possible); Outcomes objectively measured **Funding**: Spanish Institutions for funding scientific biomedical research, CIBER Fisiopatología de la Obesidad y Nutricion ´ and Instituto de Salud Carlos III via Fondo de Investigacion ´ para la Salud; Especial Action Project entitled: Implementacion ´ y evaluacion ´ de una intervencion ´ intensiva sobre la actividad física Cohorte; European Research Council;

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
	Commercial mayonnaise; Fried tomato sauce or ketchup; Snacks other than crisps; sugar-sweetened soft drinks; artificially-sweetened soft drinks; commercial fruit juices; Liquors; Spirits: whisky, vodka, gin and cognac. **Method**: Index/Score Analysis	<0.0001	Recercaixa; Generalitat Valenciana; Ministerio de Ciencia e Investigacion

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Konieczna, 2021 [37] Spain; PREDIMED Plus Analytic N=1485 **Participant Characteristic:** • Health status: 100% with Metabolic Syndrome, 3+ criteria: 75% Obesity; 93% abdominal Obesity; 22% T2D; 26% Depression • mean BMI, 32.5; WC, 107.3cm; LM 56.%; FM 40.4%; Visceral fat, 2305g • Race and/or ethnicity: White, Spanish, data NR • SEP info: Higher education, 21.6% **Selection data:** All had ≥ 3 criteria for Metabolic Syndrome and BMI 27-40 kg/m2, free of CVD at baseline, included subsample who underwent DXA scans; Excluded those with missing/extreme diet data; missing visceral fat and FFQ at baseline, missing sedentary behavior at baseline	**Dietary patterns at age(s)**: 55 to 75 years at baseline UPF (Nova food classification system, group 4 [Monteiro, 2019]) 7 sub-groups: Dairy products; Processed meat; Pre-prepared dishes; Snacks and fast-foods; Sweets; Non-alcoholic beverages; Alcoholic beverages **Method**: Index/Score Analysis	**Results at F/U:1 year** UPF & Fat mass • per-10%, β: 0.09, 95% CI: 0.06, 0.13; p<0.0001 • T2, β: 0.09, 95% CI: 0.05, 0.13 • T3, β: 0.15, 95% CI: 0.11, 0.19; p<0.0001 UPF & Visceral fat • per-10%, β: 0.09, 95% CI: 0.05, 0.13; p<0.0001 • T2, β: 0.05, 95% CI: 0.00, 0.10 • T3, β: 0.13, 95% CI: 0.07, 0.19; p<0.0001 UPF & Android-to-gynoid fat ratio • per-10%, β: 0.05, 95% CI: 0.00, 0.09; p=0.031 • T2, β: 0.05, 95% CI: 0.00, 0.10 • T3, β: 0.11, 95% CI: 0.05, 0.16; p=0.003	• Did not account for: Race/Ethnicity (100% Spanish) • Diet assessed via FFQ at baseline, 3 months, 12 months with validated FFQ; Sensitivity analyses: diet quality factors, adherence to ER-MedDiet; mediation analyses: extent to which nutritional variables and overall adiposity parameters might be responsible for the association between concurrent changes in UPF consumption and regional fat deposition; modification by age, T2D prevalence, smoking status, sedentary behavior, Obesity; Abdominal obesity **Funding**: European Research Council

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Li, 2021 [38] China; China Nutrition and Health Survey Analytic N=12451 **Participant Characteristic:** by NOVA 4 g/d • Health status: mean BMI: 22.7 to 23.2; p<0.001; Mean WC: 78.9 to 80.9, p<0.001; Overweight/Obesity: 21.7% to 26.9%; p<0.001; Central Obesity; 24.9% to 28.2%; p=0.070; DM: 9.2% • Race and/or ethnicity: NR (100% Chinese) • SEP: Income: Low, ~ 20 to 32%; Medium, 32 to 34%; High, 35 to 49%; p<0.001 **Selection data:** Enrolled those with at least two surveys 1997-2011; plausible energy intake, and diet and anthropometric data	**Age at dietary pattern:** mean 43.7 years UPF (Nova food classification system, group 4 [Monteiro, 2019]) 10 main sources (~51% all UPF): Instant pork-mince steam bun; Bread; Instant noodle; Cookies; Cake; Instant pork-mince dumpling; Sausage; Liquor; Soybean paste; Packaged snacks **Method**: Index/Score Analysis	**F/U: 12 years total, NR** UPF & Risk of Overweight/Obesity, 0g/d, HR: 1, ref • 1-19 g/d, HR: 1.45, 95% CI: 1.26, 1.65 • 20-49 g/d, HR: 1.34, 95% CI: 1.15, 1.57 • ≥50 g/d, HR: 1.45, 95% CI: 1.21, 1.74 • p<0.001 UPF & WC, 0g/d, HR: 1, ref • 1-19 g/d, HR: 1.54, 95% CI: 1.38, 1.72 • 20-49 g/d, HR: 1.35, 95% CI: 1.19, 1.54 • ≥50 g/d, HR: 1.50, 95% CI: 1.29, 1.74 • p<0.001	• Did not account for: Anthropometry • Diet assessed with repeat (3) 24 hour recalls; Food-processing status discussed and based on consensus e.g., 'fruit or milk drinks' were UPF if containing sweeteners, preservatives, or other additives' • Other factors associated with weight status were age, education, urbanization (strongest), smoking, and physical activity, but not statistically significant **Funding**: None

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Livingstone, 2022 DP [39] United Kingdom; BIOBANK Analytic N=11735 **Participant Characteristic:** • Health status: Mean BMI, 24.6; WC, cm, 83; BF%, 27.1 • Race and/or ethnicity: 100% White British • SEP info: o Education: College or university degree, 54.6%; A/AS levels , 13.3%; O levels/GCSE/CSEs, 19.8%; Professional qualifications, 8.5%; None/prefer not to answer, 3.8% o Townsend Deprivation Index: Least 24%, 2nd least 24%, Mid 20%, 2nd Most 18%, Most 14% **Selection data:** Excluded those with missing exposure/outcome/covariate/ >10% genetic data, <2 diet assessments; pregnancy; non-White-British ancestry; heterozygous outliers; or second cousins of pairs.	**Dietary patterns at age(s)**:40 to 69 years "DP1": higher intake of buns, cakes and pastries, confectionary and sweet biscuits; sugar-sweetened soft drinks; high-fat cheese; butter; processed meats; negatively associated with consumption of fruits, vegetables, low-fat yoghurt **Method**: RRR: Response variables were discretionary foods and beverages [%E]; SFA [%E]; fiber density [g/MJ]	**Results at F/U:6.3 years, mean** DP1 and: • Risk of Obesity, HR: 1.09, 95% CI: 0.99,1.19 • Risk of High-% body fat, HR: 1.03, 95% CI: 0.98,1.08 • Risk of High-WC, HR: 1.08, 95% CI: 1.03,1.14	• Did not account for: N/A (all controlled for) • Diet assessed at five times with 24-h recalls and "usual baseline" DP based on average from ≥ 2 **Funding**: Select authors funded by National Health and Medical Research Council Emerging Leadership Fellowship; Lister Prize Fellowship

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Mendonca, 2016 [40] Spain; SUN Cohort Analytic N=8,451 **Participant Characteristic:** • Health status: BMI: ~22 kg/m2; Weight: ~62-63 kg; Smoking status: ~20-24% current smoker, ~25-26% former smoker; PA: ~22-23 MET-h/wk; TV time: ~1.5-1.6 h/d; Q4 v. Q1 UPF had highest BMI, more likely current smokers, and more TV time • Race and/or ethnicity: NR • SEP info: Education: ~77-79% graduated university, ~16-19% master or doctoral; Marital status: ~45-48% single, ~46-50% married **Selection data:** Excluded those with overweight or obese at baseline; total energy intake values outside of predefined limit; pregnancy at baseline or during follow-up; previously diagnosis of chronic disease at baseline (e.g.DM, Cx, CVD); weight change >10 kg in the 5 y preceding entry into the study; lost to follow-up, missing values in ≥1 variable of interest	**Dietary patterns at age(s)**:37.6 [11.0] years UPF (Nova food classification system, group 4 [Monteiro, 2019]) 8 main sources: Processed meat (ham, sausage, chorizo, salami, mortadella, hamburger); Cookies; Pastries (muffins, doughnuts, croissants and confectionary); Breakfast cereals; SSBs; Fruit drinks in bottles; Margarine; Chocolate **Method**: Index/Score Analysis	**Results at F/U:8.9 years median** UPF & Risk of Overweight/Obesity (Q1: HR 1, ref) • Q2: HR 1.15, 95%CI: 1.01, 1.32 • Q3: HR 1.24, 95%CI: 1.09, 1.43 • Q4: HR 1.26, 95%CI: 1.10, 1.45	• Did not account for: Alcohol (Differed at baseline but not adjusted; unclear if included); Race/ethnicity (all Spanish) • Diet assessed once via FFQ (validated) at baseline; FFQ was not designed for UPF **Funding**: Carlos III Health Institute; European Regional Development Fund, regional government of Navarra, and University of Navarra

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Mirmiran 2022 [41] Iran; Tehran Lipid/Glucose Analytic N=1299 **Participant Characteristic:** • Health status: 61% Overweight/Obesity; ~80% non-smokers • Race and/or ethnicity: NR (Iranian) • SEP: Most 12 years + education **Selection data:** Excluded those with unhealthy metabolic phenotype, younger than 19 years old, missing data/LFU/implausible dietary data	**Age at dietary pattern:** 29 to 49 years UPF (Nova food classification system, group 4 [Monteiro, 2019]) 9 sub-groups: Dairy products (ice cream, chocolate milk); Processed meat (sausages, burgers, hot dogs); Pizza; Cakes and biscuits; Candies and chocolates; Mayonnaise, margarine and hydrogenated oils; Soft drinks (carbonated soft drinks); Salty snacks (potato chips and pufak); Creamy cheese **Method**: Index/Score Analysis	**F/U: ~6 years** UPF & Risk of Metabolically Unhealthy-Normal Weight (MUNW) (Q1, ref) • Q2, HR: 0.85, 95% CI: 0.51, 1.40 • Q3, HR: 1.43, 95% CI: 0.85, 2.39 • Q4, HR: 1.83, 95% CI: 1.14, 2.92 • per 10%, HR: 1.54, 95% CI: 1.20, 1.98; p=0.001 UPF & Risk of Metabolically Unhealthy-Overweight (MUOW)(Q1, ref) • Q2, HR: 1.01, 95% CI: 0.77, 1.34 • Q3, HR: 1.11, 95% CI: 0.83, 1.48 • Q4, HR: 1.19, 95% CI: 0.90, 1.57 • per 10%, HR: 1.02, 95% CI: 1.01, 1.03; p=0.021 Sensitivity analyses of individual UPF support Processed meat and Salty snack sub-groups as significant drivers for both MUOW and MUNW	• Did not account for: Race/Ethnicity (Iranian, data NR), Physical activity (differed by UPF in MHOW), Alcohol (most were non-consumers), Smoking (most non-smokers) • Diet assessed once via FFQ; Misclassification possible due to UPF intake based on FFQ; Outcomes objectivey measured; Indirect outcome of 'metabolically unhealthy phenotype' stratified by baseline status of normal weight and Overweight/Obesity • **Funding**: Shahid Beheshti University Medical Sciences

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Pant, 2023 [42] Australia; ALSWH Analytic N=10006 **Participant Characteristic:** Health status: • BMI: Mean 26.8 (Q2 & Q3 higher BMI); Overweight, 32-34%; Obesity, 21-25% • T2D, 3-6% Hypertension, 25-30%; Cancer, 3-4% ~25% post-menopause Race and/or ethnicity: NR SEP info: • Education: 15-17% None, 29-33% primary school, 15-18% high school; 3-4% trade, 16-18% diploma, 9-10% university degree, 5-7% Master or PhD degree • Income, $AU: 6-8% <16K; 50-52% 16K-51,999; 42-43% >51,999 **Selection data:** Women without CVD and with complete data (FFQ, plausible)	**Age at dietary pattern:** 52.5 y, mean (50 to 55y, third survey year 2001) UPF (Nova food classification system, group 4 [Monteiro, 2019]) Top 12 sources in rank order: Ready-made meals; Industrial packaged breads; Milk-based drinks; Breakfast cereals; Processed meats; Margarine and other spreads; Industrial potato chips; Processed cakes; Snacks; Ice cream; Biscuits; Confectionary **Method**: Index/Score Analysis	**F/U: 15 years ~ until 2016** UPF & Risk of Obesity • Q2, OR: 1.07, 95% CI: 0.80, 1.43, p=0.67 • Q3, OR: 1.29, 95% CI: 0.97, 1.73, p=0.08 • Q4, OR: 1.05, 95% CI: 0.77, 1.43, p=0.76 • Q5, OR: 1.16, 95% CI: 0.85, 1.60, p=0.36 • p-trend=0.52	• Did not account for: Race/Ethnicity, • Diet assessed once via FFQ; Misclassification possible due to UPF intake based on FFQ; Outcome self-reported; Primary outcome was CVD **Funding**: CAUL and its Member Institutions

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Rauber, 2021 [43] United Kingdom; BIOBANK Analytic N=22659 **Participant Characteristic:** • Health status: BMI, mean: ~26.7 kg/m2; Obesity: ~19%; WC, mean: ~87.9-89.2 cm; Abdominal obesity: ~25%; mean % Body Fat: ~31% ; Physical activity: ~15-18% low, ~36-37% moderate, ~31-37% high, ~12-15% missing • Race and/or ethnicity: NR; Participants from across England, Scotland, and Wales • SEP info: all participants evenly distributed (~20% were in each deprivation index category); UPF Q4 v.Q1 were more likely to be in most deprived **Selection data:** Excluded those with obesity or high WC at baseline, implausible food intake, pregnant at baseline, invalid BMI, WC, or body fat data	**Dietary patterns at age(s)**:40 to 69 y at baselineInclude UPF (Nova food classification system, group 4 [Monteiro, 2019]) 6 main sources: Snacks, desserts (33%, confectionary, pastries, packaged salty snacks); Breads (21%, bagel, buns, rolls); Ready-to-heat meals (16% frozen or shelf-stable); Beverages (15%, milk-based, soft and fruit drinks, fruit juices, alcoholic, coffee); Spreads, sauces, other (9% e.g., margarine, gravies); Cereals breakfast (6% sweetened oat/cornflake cereals) **Method**: Index/Score Analysis	**F/U: 5.6 y for Ob or high WC, 5.8 y for ≥ 5% BMI or WC increases, 1.8 y for ≥ 5% BF increase** UPF & Risk of Obesity • Q2 , HR: 1.50, 95% CI: 0.87, 2.58 • Q3 , HR: 1.03, 95% CI: 0.58, 1.83 • Q4 , HR: 1.79, 95% CI: 1.06, 3.03; p=0.068 • per 10%, HR: 1.10, 95% CI: 0.99, 1.22 UPF & ≥ 5% Body Fat increase • Q2 , HR: 1.05, 95% CI: 0.96, 1.16 • Q3 , HR: 1.05, 95% CI: 0.95, 1.16 • Q4 , HR: 1.14, 95% CI: 1.03, 1.25; p<0.001 • per 10%, HR: 1.03, 95% CI: 1.01, 1.05 UPF & ≥ 5% BMI increase • Q2 , HR: 1.07, 95% CI: 0.98, 1.18 • Q3 , HR: 1.07, 95% CI: 0.97, 1.17 • Q4 , HR: 1.31, 95% CI: 1.20, 1.43; p<0.001 UPF & high WC • Q2 , HR: 1.17, 95% CI: 1.03, 1.34 • Q3 , HR: 1.21, 95% CI: 1.06, 1.38 • Q4 , HR: 1.30, 95% CI: 1.14, 1.48; p<0.001 • per 10%, HR: 1.06, 95% CI: 1.03, 1.08 UPF & ≥ 5% WC increase • Q2 , HR: 1.13, 95% CI: 1.05, 1.22 • Q3 , HR: 1.18, 95% CI: 1.10, 1.27 • Q4 , HR: 1.35, 95% CI: 1.25, 1.45; p=0.014 • per 10%, HR: 1.06, 95% CI: 1.05, 1.08	• Did not account for: Race/Ethnicity • Diet assessed with 24h recall **Funding**: Fundação de Amparo à Pes quisa do Estado de São Paulo (FAPESP)

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Rudakoff 2022 [44] Brazil; 1978/1979 Ribeirão Preto Analytic N=1021 (LM n=815) **Participant Characteristic:** • Health status: NR • Race and/or ethnicity: 62% "White", 6% "Black", 31% "Brown", 1% "Yellow/Oriental" • SEP info: Income, Min. Wage (MW): <5, 34%; 5-9.9 31%; >9.9 27% **Selection data:** Excluded those w Metabolic Syndrome at baseline, LFU, missing or implausible diet data; Birth-cohort	**Dietary patterns at age(s)**:23 to 25yInclude UPF (Nova food classification system, group 4 [Monteiro, 2019]) 14 items: Sugar-sweetened beverages; Savory snacks; Dairy products; Candies; Cold meats; Cake; UP Bread; Crackers; Instant noodles; Snacks; Mayonnaise; Granola; Margarine; Distilled drinks **Method**: Index/Score Analysis	**Results at F/U:~14y (age 37 to 39y)** UPF % g and: • BMI, β: 0.04, 95% CI: 0.00, 0.08; p= 0.058 • FMI, β: 0.04, 95% CI: 0.00, 0.07; p= 0.021 • % Body fat, β: 0.09, 95% CI: 0.02, 0.16; p= 0.010 • Android FM, β: 0.01, 95% CI: 0.00, 0.02; p= 0.005 • Gynoid FM, β: 0.02, 95% CI: 0.00, 0.04; p= 0.017 • Android/Gynoid FM ratio, β: 0.0006, 95% CI: −0.0004, 0.002; p= 0.225 UPF % TEI and: • BMI, β: 0.06, 95% CI: 0.00, 0.12; p= 0.038 • FMI, β: 0.06, 95% CI: 0.00, 0.10; p= 0.018 • Body fat %, β: 0.11, 95% CI: 0.02, 0.21; p= 0.017 • Android FM, β: 0.01, 95% CI: 0.00, 0.02; p= 0.071 • Gynoid FM, β: 0.02, 95% CI: 0.00, 0.04; p= 0.038 • Android/Gynoid FM ratio, β: 0.0004, 95% CI: −0.0001, 0.002; p= 0.556	• Did not account for: Anthropometry (at baseline), Race/Ethnicity • Diet assessed once via FFQ; Misclassification possible due to UPF intake based on FFQ; Outcomes objectively measured **Funding**: Coordination for the Improvement of Higher Education Personnel-Brazil, the National Council for Scientific and Technological Development -CNPq; Research Support Foundation of the State of São Paulo; Teaching, Research, and Assistance Support Foundation

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Santos, 2023 [45] Brazil; NutriNet-Brasil Analytic N=9551 **Participant Characteristic:** • Health status: ~48% Overweight or Obesity; 76% never smoker; 58% Physically active • Race and/or ethnicity: NR (Brazilian) • SEP info: Education: 88% 12 years+; 63% from Southeast and 18% from South regions (more economically developed) **Selection data:** Excluded those with pregnancy; implausible (< 2 months pre-baseline, >6 months post-F/U; outlier) or missing BMI or covariate data	**Dietary patterns at age(s)**:18 years + UPF (Nova food classification system, group 4 [Monteiro, 2019]) 3 sub-groups with 23 items comprising "UPF-score": 1) UPF Snacks: packaged chips or crackers; cookies; cake snacks; cereal bars; ice cream or popsicle; chocolate bar or candies; and sugared breakfast cereals (7 items); 2) UPF Drinks: regular or diet soda; canned or bottled fruit juice (Del Valle®-type); powdered drink mix (Tang®-type); chocolate-flavoured drink (Nescau®-type); tea-based beverage (ice tea-type); and fruit- or chocolate-flavoured yogurt (6 items); 3) UPF Other: sausage, hamburger or nuggets; ham, salami or mortadella; loaf, hot dog, or hamburger bun; margarine; French fries (either frozen or from restaurant chains such as McDonald's®); mayonnaise, ketchup or mustard; store-bought salad dressing; instant noodles (Miojo®-type) or packaged soup; pizza (either frozen or from restaurant chains, such as Pizza Hut® or Domino's®); and frozen lasagna or other frozen ready-made meals (10 items) **Method**: Index/Score Analysis	**F/U: 13 months** UPF & BMI gain after 15 months, • Q2, RR: 1.07, 95% CI: 0.92, 1.25 • Q3, RR: 1.18, 95% CI: 1.02, 1.38 • Q4, RR: 1.23, 95% CI: 1.06, 1.43 • Q5, RR: 1.34, 95% CI: 1.15, 1.56 • linear, p-trend<0.001 UPF & BMI gain after 15 months, • Q2, RR: 0.91, 95% CI: 0.80, 1.04 • Q3, RR: 0.82, 95% CI: 0.72, 0.93 • Q4, RR: 0.84, 95% CI: 0.73, 0.98 • Q5, RR: 0.80, 95% CI: 0.69, 0.94 • linear, p-trend<0.01	• Did not account for: Race/ethnicity (Brazilian); TEI • Diet assessed once with 24-hour recalls (~ 3); Self-reported height and weight used for BMI; Mediation showed 26% of total effect on BMI gain due to Nova 4 score and 15% due to Nova 1 score **Funding**: Brazilian Ministry of Health through CNPq, the Brazilian National Council for Scientific and Technological Development; FAPSEP; São Paulo state Research Foundation; UMANE
Tan 2023 [46] Korea; KOGES Analytic N=17310 **Participant Characteristic:** • Health status: mean BMI ~22; majority of women non-smokers (97-98%) and non-alcohol consumers; majority of men consumd alcohol	**Dietary patterns at age(s)**:40 years and older Food Compass Score (FCS) [Mozzafarrian, 2021]; UPF (Nova food classification system, group 4 [Monteiro, 2019]) UPF, FCS (Nova 4, 20 items w/ beverages): Ramen; Dumpling/dumpling with soup; Corn flakes; Loaf of bread, sandwich, toast; Bread with few red beans; Other bread; Cakes/chocolate pie; Parched grains powder (pre-eating); Cookies/crackers/snacks;	**F/U: 5 years** FCS & Risk of Obesity • ♂ Q2 (more UPF), HR: 1.228, 95% CI: 0.928, 1.626 • ♂ Q3, HR: 1.052, 95% CI: 0.786, 1.408 • ♂ Q4 (less UPF), HR: 0.898, 95% CI: 0.662, 1.219; p-trend=0.3037 • ♀ Q2 (more UPF), HR: 0.996, 95% CI: 0.832, 1.193 • ♀ Q3, HR: 0.878, 95% CI: 0.731, 1.053 • ♀ Q4 (less UPF), HR: 0.759, 95% CI: 0.628, 0.916; p=0.007	• Did not account for: Race/ethnicity (Korean) • Diet assessed via FFQ at baseline and F/U (avg. used); Misclassification possible due to UPF intake based on FFQ; Q4 UPF also had lowest aMED scores; Outcome methods calculated BMI but did

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
(67-74%) • Race and/or ethnicity: NR (Korean) • SEP info: Education: Majority some or high **Selection data:** Excluded those with metabolic diseases at baseline (e.g., CVD, DM); missing/implausible diet or GBCO data; Included 73% female participants and reported data stratified by sex only (not pooled);	Candy/chocolate; Pizza/hamburger; Ham/sausage; Fish paste/ crab flavoring; Yogurt; Ice cream; Soy milk; Coffee; Green tea; Carbonated drinks; Other drinks. UPF, Nova 4 (14 items excluded beverages): Ramen; Dumpling/dumpling with soup; Corn flakes; Loaf of bread, sandwich, toast; Bread with few red beans; Other bread; Cake; Parched grains powder (pre-eating); Cookies; Candy; Pizza; Ham; Flavored crab; Ice cream. Nova 3 e.g., noodles, kimchi Nova 1+ 2: e.g., raw, fresh, frozen vegetables, fruit, legumes, rice, etc. + 3 processed culinary ingredients: jam, sugar, cream **Method**: Index/Score Analysis	Nova 4 & Risk of Obesity • ♂, g, Q2, HR: 0.826, 95% CI: 0.608, 1.121 • ♂, g, Q3, HR: 1.002, 95% CI: 0.733, 1.371 • ♂, g, Q4, HR: 1.037, 95% CI: 0.728, 1.478; p=0.4126 • ♂, % g, Q2, HR: 1.060, 95% CI: 0.780, 1.442 • ♂, % g, Q3, HR: 1.035, 95% CI: 0.749, 1.430 • ♂, % g, Q4, HR: 1.340, 95% CI: 0.936, 1.918; p=0.0868 • ♀ g, Q2, HR: 1.071, 95% CI: 0.887, 1.292 • ♀ g, Q3, HR: 1.132, 95% CI: 0.925, 1.386 • ♀ g, Q4, HR: 1.360, 95% CI: 1.072, 1.725; p=0.0087 • ♀ % g, Q2, HR: 0.994, 95% CI: 0.823, 1.200 • ♀ % g, Q3, HR: 1.196, 95% CI: 0.980, 1.459 • ♀ % g, Q4, HR: 1.508, 95% CI: 1.191, 1.909; p=0.0001 Nova 4 & BMI: • ♂, g, β: 0.002, 95% CI: 0.001, 0.003; p=0.0026 • ♂,% g, β: 0.027, 95% CI: 0.010, 0.043; p=0.0022 • ♀, g, β: 0.001, 95% CI: 0.000, 0.002; p=0.0016 • ♀, % g, β: 0.017, 95% CI: 0.006, 0.027; p=0.0024 Nova 3, g/d & Risk of Obesity • ♂, g, Q2, HR: 1.038, 95% CI: 0.759, 1.420 • ♂, g, Q3, HR: 1.332, 95% CI: 0.971, 1.826 • ♂, g, Q4, HR: 0.982, 95% CI: 0.689, 1.399; p=0.9186 • ♀, g, Q2, HR: 0.984, 95% CI: 0.812, 1.193 • ♀, g, Q3, HR: 1.041, 95% CI: 0.857, 1.265 • ♀, g, Q4, HR: 1.034, 95% CI: 0.839, 1.274; p=0.6476	NR if weight/height was measured or reported **Funding**: National Genome Research Institute, Korea Centers for Disease Control and Prevention

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
		Nova 1+2, g/d & Risk of Obesity • ♂, g, Q2, HR: 1.201, 95% CI: 0.892, 1.619 • ♂, g, Q3, HR: 1.211, 95% CI: 0.880, 1.667 • ♂, g, Q4, HR: 0.974, 95% CI: 0.669, 1.418; p=0.5701 • ♀, g, Q2, HR: 0.82, 95% CI: 0.678, 0.990 • ♀, g, Q3, HR: 0.815, 95% CI: 0.925, 1.00 • ♀, g, Q4, HR: 0.716, 95% CI: 0.565, 0.907; p=0.0201	

[a] Abbreviations: BMI, body mass index; DM, Diabetes mellitus; DXA, Dual-energy X-ray absorptiometry; FFM, Fat-free mass; FFMI, Fat-free mass index; FFQ, Food frequency questionnaire; FM, Fat mass (total, unless specified); FMI, Fat mass index; F/U, Follow-up; ITT, intent-to-treat; LFU, lost to follow-up; N/A, Not applicable; NR, not reported; OR, odds ratio; PP, per-protocol; Q, quantile; SEP/SES, Socioeconomic position/status; T, tertile; T2D, Type 2 Diabetes; UPF, Ultra-processed food; WC, waist circumference; ♂ male; ♀ female

Table 13 Risk of bias for interventions examining dietary patterns with varying amounts of ultra-processed food consumed by adults and older adults and growth, body composition and risk of obesity*

Article	Randomization	Deviations from intended interventions (effect of assignment)	Deviations from intended interventions (per-protocol)	Missing data	Outcome measurement	Selection of the reported result	Overall
Calvo-Malvar, 2021[32]	LOW	LOW	SOME CONCERNS	LOW	LOW	HIGH	SOME CONCERNS

* Possible ratings of low, some concerns, or high determined using the "Cochrane Risk-of-bias 2.0" (RoB 2.0) (August 2019 version)" (Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, Cates CJ, Cheng H-Y, Corbett MS, Eldridge SM, Hernán MA, Hopewell S, Hróbjartsson A, Junqueira DR, Jüni P, Kirkham JJ, Lasserson T, Li T, McAleenan A, Reeves BC, Shepperd S, Shrier I, Stewart LA, Tilling K, White IR, Whiting PF, Higgins JPT. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366**: l4898.

Table 14 Risk of bias for observational studies examining dietary patterns with varying amounts of ultra-processed food consumed by adults and older adults and growth, body composition and risk of obesity[a]

Article	Confounding	Exposure classification	Participant Selection	Post-exposure interventions	Missing data	Outcome measurement	Selection of the reported result	Overall
Beslay, 2020[31]	Low	Low	Some concerns	Low	Some concerns	High	Low	High
Canhada, 2019[33]	Some concerns	Some concerns	Some concerns	Low	Some concerns	Low	Low	Some concerns
Canhada, 2023[34]	Low	High	Some concerns	Low	Some concerns	Low	High	High
Cordova, 2021[35]	Low	Some concerns	Some concerns	Low	Some concerns	High	Some concerns	High
González-Palacios[36]	High	High	Some concerns	Some concerns	Low	Low	Some concerns	High
Konieczna, 2021[37]	Low	Some concerns	Some concerns	Some concerns	Some concerns	Low	Some concerns	High
Li, 2021[38]	High	Some concerns	Low	Low	Some concerns	Low	Some concerns	High
Livingstone, 2022[39]	Low	Low	Some concerns	Low	Some concerns	Low	Some concerns	Some concerns
Mendonca, 2016[40]	Some concerns	High	Some concerns	Low	Low	High	Some concerns	High
Mirmiran 2022[41]	High	High	Some concerns	Low	High	Low	Some concerns	High
Pant, 2023[42]	Some concerns	High	Low	Low	Some concerns	High	Some concerns	High
Rauber, 2021[43]	Some concerns	Some concerns	Low	Low	High	Low	Some concerns	High
Rudakoff, 2022[44]	High	High	Some concerns	Low	Some concerns	Low	Some concerns	High
Santos, 2023[45]	High	Some concerns	Low	Low	Some concerns	High	Low	High
Tan 2023[46]	Some concerns	High	Low	Low	High	High	Very high	Very high

[a] Possible ratings of low, some concerns, high, very high, not applicable, or no information no information determined using the "Risk of Bias in Non-randomized Studies of Exposures (ROBINS-E)" tool (ROBINS-E Development Group Higgins J, Morgan R, Rooney A, et al. Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E). Launch version, 1 June 2022. Available from: https://www.riskofbias.info/welcome/robins-e-tool.) *Low risk of bias except for concerns about uncontrolled confounding.

Pregnancy and postpartum

Two articles met the inclusion criteria examining the relationship between dietary patterns with varying amounts of UPF consumed during pregnancy and/or postpartum and gestational weight gain and postpartum weight change. Both articles analyzed prospective cohort studies.[47,48]

Description of the evidence

Population

One study was conducted in the United States[47] and another one in Brazil[48] and included 367 and 584 participants, respectively. Both articles included >50% of the participants with overweight and obesity and Dias and colleagues, included only participants with gestational diabetes mellitus.[48] Cummings and colleagues, noted that participants were 17% “Black”, 5.3% “Asian”, 6.3% “Other or multiracial”, and 8.6% Hispanic and income-poverty ratio of 3.84.[47] Dias and colleagues, reported that 49% of the participants were non-White and 21% of the participants had family income below minimum wage.[48]

Intervention/exposure and comparator

Cummings and colleagues[47] collected dietary data using 24-hour dietary recall at multiple time-points during pregnancy and postpartum period and examined scores on the “Instant” dietary pattern comprised of ready-to-heat pre-prepared pies, pasta, and pizza dishes; mass-produced packaged breads; reconstituted meats; sweet or savory packaged snacks; confectionery desserts; sweetened drinks. Dias and colleagues[48] used a brief food-frequency questionnaire to collect dietary data during pregnancy and 6-mo postpartum periods and derived the “Risk” dietary pattern from factor/cluster analysis comprised of Fried foods; Cookies and sweets; Sweetened beverages; Processed meat; Red meat with visible fat.

Outcomes

Cummings and colleagues assessed weight during pregnancy and categorized gestational weight gain as inadequate, adequate or excessive, based on 2009 Institute of Medicine guidelines[*]. Postpartum weight change was defined as the change in weight between baseline (<12 weeks of pregnancy) and one year postpartum, both measured by the investigators. Percent of gestational weight gain retained was calculated by multiplying 100 by the difference in weight between the last prenatal medical visit (investigator measured) and one year postpartum (investigator measured), divided by gestational weight gain. Dias et al. reported the variation in BMI between 2-mo and 12-mo postpartum. These outcome measures were calculated based on the self-reported weight by the participants.

Synthesis of the evidence

Pregnancy

One study assessed the association between dietary patterns with varying amounts of UPF and gestational weight gain. The authors reported that a dietary pattern with greater amounts of foods classified as UPF (per SD) during pregnancy was significantly associated with higher risk of excessive gestational weight gain, but not significantly associated with the risk of inadequate gestational weight gain.

Postpartum

Two studies reported that there was no association between consumption of dietary patterns with UPF during postpartum and either % gestational weight gain retained and postpartum weight change[47] or with BMI at 12 months postpartum[48]

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[*] Institute of Medicine. Weight gain during pregnancy: reexamining the guidelines. Washington, DC: National Academies Press; 2009

Conclusion statement and grade

Insufficient evidence is available to adequately assess the body of evidence for consistency, directness, risk of bias (see Table 17), precision, and generalizability. This body of evidence is less likely to have publication bias as it includes only 2 studies with mixed and/or null findings from relatively small sample sizes.

Table 15. Conclusion statement, grades dietary patterns with varying amounts of ultra-processed food consumed during pregnancy and gestational weight gain.

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy with varying amounts of ultra-processed food and gestational weight gain because there is not enough evidence available**
Grade	Grade not assignable
Body of Evidence	1 article from a prospective cohort study
Rationale	The body of evidence cannot be adequately assessed due to too few studies meeting criteria for inclusion.

Table 16. Conclusion statement, grades dietary patterns with varying amounts of ultra-processed food consumed during postpartum and postpartum weight change.

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during postpartum with varying amounts of ultra-processed food and postpartum weight change because there is not enough evidence available.**
Grade	Grade not assignable
Body of Evidence	2 articles from prospective cohort studies
Rationale	The body of evidence cannot be adequately assessed due to too few studies meeting criteria for inclusion.

Table 17. Studies examining the relationship between dietary patterns with varying amounts of ultra-processed food consumed during pregnancy and postpartum and postpartum and gestational weight gain and postpartum weight change.[i*]

Article Information	Intervention/exposure and comparator	Results	Methodological considerations
Cummings, 2022 [47] **PCS, United States, PEAS** Analytic N=321 • Age (y): 30.5±4.7 • Smoking (%): Current: 2; Former: 18 Race/Ethnicity (%): White: 71; Black: 17, Asian: 5, Other or multiracial: 6; Hispanic: 9 • Socioeconomic position: Income-Poverty Ratio: 3.84±1.97 • Education (%): College degree: 72 • Pre-pregnancy BMI (%): <18.5: 0.0; ≥25: 25.1; >30: 27.1 • GWG (%): Inadequate: 19; Adequate: 34; Excessive: 47	**UPF** (Nova food classification system, group 4 [Monteiro, 2019[1]]) (continuous adherence, % TEI z-scored) ASA24 at: <12 weeks, 16-22 weeks, 28-32 weeks gestation, ~2 months, 6 months, 1y postpartum **Dietary pattern description**: Positive: 'instant' foods; ready-to-heat pre-prepared pies, pasta, and pizza dishes; mass-produced packaged breads; reconstituted meats; sweet or savory packaged snacks; confectionery desserts; sweetened drinks **Outcome and assessment methods:** GWG, PPWR, PPWC assessed at ~1y postpartum. GWG categorized as inadequate, adequate and excessive, based on IOM (2009) recommendations. PPWR (%) calculated as difference in weight from last prenatal medical visit to 1y postpartum divided by GWG, multiplied by 100. PPWC (kg) calculated by subtracting weight at baseline (<12 GW) from weight at 1y postpartum Weight, height measured by investigators, and from prenatal medical records.	**GWG,** OR, % per-SD UPF during pregnancy Inadequate: 0.88, 95% CI: 0.63, 1.23, p=0.45 Excessive: 1.31, 95% CI: 1.01, 1.70, p=0.045 **PPWR,** Linear regression, % per-SD UPF during postpartum, β±SE (95% CI) -4.33±3.39 (-11, 2.34), p=0.202 **PPWC,** Linear regression, kg per-SD UPF during postpartum; β±SE (95% CI) -0.44±0.36 (-1.14, 0.27), p=0.222	**Key confounders accounted for:** Age, Physical activity, Pre-pregnancy BMI and/or GWG (PPWR only), Socioeconomic position, Smoking status **Key confounders not accounted for**: Race/ethnicity, Parity, Human milk feeding status **Other covariates:** TEI, time **Limitations**: Issues with confounding and some concerns with exposure measurement, missing data and selection of reported result **Funding:** NICHD, NIH
Dias, 2023[48] **PCS, Brazil, LINDA-Brasil** Analytic N=584 • Age (y): 18 y or older (54% 30-39 y) • 100% participants with GDM • Race/Ethnicity (%):51% White, 49% Non-White • Socioeconomic position: 23% ≥3 Minimum wage (highest), 25% 2 to <3, 37% 1 to <2, 15% <1 (lowest); • 92% living with partner • Pre-pregnancy BMI: 42% Ob, 39% OW, 19% • Postpartum 2-months F/U: 42% Obesity, 44% Overweight, 14% Normal/Underweight • Excessive GWG: 21.5%, Adequate GWG, 25.3%, Insufficient GWG 53.2%	**'Risk'** dietary pattern (tertiles) Short-FFQ, applied during pregnancy and postpartum (6-months) **Dietary pattern description**: Positive: Fried foods; Cookies and sweets; Sweetened beverages; Processed meat; Red meat with visible fat **Outcome and assessment methods:** Variation in BMI between 2- and 12-months postpartum, based on self-reported weight	**Change in BMI, 12 months postpartum** T1: Ref T2: 1.09, 95% CI: 0.86, 1.38 T3, 1.09, 95% CI: 0.86, 1.37	**Key confounders accounted for:** Age, Sex, Alcohol intake, Race and/or ethnicity, Socioeconomic position, Anthropometry, Smoking, Breastfeeding during F/U period **Key confounders not accounted for**: Physical activity **Other covariates:** Study center, parity **Limitations**: 100% GDM participants, self-reported outcomes, misclassification possible due to UPF intake from FFQ, Potential influence of knowledge of 2 months weight measure on postpartum diet assessment **Funding:** Brazilian National Council of Technological and Scientific Development; Eli Lilly Non-Communicable Diseases Partners; Financiamento e Incentivo à Pesquisa do Hospital de Clínicas de Porto Alegre

[*] Abbreviations: FFQ, Food frequency questionnaire; GDM, Gestational diabetes mellitus; GWG, Gestational weight gain; PPWR, Postpartum weight retention; PPWC, Postpartum weight change; TEI, total energy intake; UPF, ultra-processed food

Table 18. Risk of bias for observational studies examining dietary patterns with varying amounts of ultra-processed food consumed during pregnancy and/or postpartum and gestational weight and postpartum weight change.[*]

Article	Confounding	Exposure classification	Participant Selection	Post-exposure interventions	Missing data	Outcome measurement	Selection of the reported result	Overall
Cummings, 2022[47]	High	Some concerns	Low	Low	Some concerns	Low	Some concerns	High
Dias, 2023[48]	Low	Low	Low	Low	High	High	Some concerns	High

[*] Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias in Non-randomized Studies of Exposures (ROBINS-E)" tool (ROBINS-E Development Group (Higgins J, Morgan R, Rooney A, Taylor K, Thayer K, Silva R, Lemeris C, Akl A, Arroyave W, Bateson T, Berkman N, Demers P, Forastiere F, Glenn B, Hróbjartsson A, Kirrane E, LaKind J, Luben T, Lunn R, McAleenan A, McGuinness L, Meerpohl J, Mehta S, Nachman R, Obbagy J, O'Connor A, Radke E, Savović J, Schubauer-Berigan M, Schwingl P, Schunemann H, Shea B, Steenland K, Stewart T, Straif K, Tilling K, Verbeek V, Vermeulen R, Viswanathan M, Zahm S, Sterne J). Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E). Launch version, 1 June 2022. Available from: https://www.riskofbias.info/welcome/robins-e-tool.) *Low risk of bias except for concerns about uncontrolled confounding.

Summary of conclusion statements and grades

The 2025 Dietary Guidelines Advisory Committee answered the systematic review question, “What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?”, with the following conclusion statement[s].[*]The grades reflect the strength of the evidence underlying the conclusion statements.

Infants and Young Children up to age 24 months

- A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months with varying amounts of ultra-processed food and growth, body composition, and risk of obesity because of substantial concerns with consistency and directness in the body of evidence. (Grade Not Assignable)

Children and Adolescents

- Dietary patterns consumed by children and adolescents with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of overweight. This conclusion statement is based on evidence grade as limited. (Grade: Limited)

Adults and Older Adults

- Dietary patterns consumed by adults and older adults with higher amounts of foods classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of obesity and/or overweight. This conclusion statement is based on evidence grade as limited. (Grade: Limited)

Pregnancy and Postpartum

- A conclusion statement cannot be drawn about the relationship between dietary consumed during pregnancy patterns with varying amounts of ultra-processed food and gestational weight gain because there is not enough evidence available. (Grade Not Assignable)
- A conclusion statement cannot drawn about the relationship between dietary patterns consumed during postpartum with varying amounts of ultra-processed food and body composition, and risk of obesity because there is not enough evidence available. (Grade Not Assignable)

Research recommendations

- Conduct well-controlled trials in the U.S. that examine dietary patterns with higher compared to lower amounts of ultra-processed food (UPF) that are matched for energy-density and conducted over an intervention length ≥ 12 weeks in relation to growth, body composition, and risk of obesity outcomes. Not controlling for diet quality limits the ability to isolate the effects on outcomes due to the differences in UPF from differences in diet quality. Trials that last less than 12 weeks provide limited information on the long-term health impacts on growth, body composition, and risk of obesity outcomes from dietary pattern consumption.
- Replicate findings from observational studies conducted outside of the U.S with prospective cohort studies among populations in the U.S while considering diversity in race and/or ethnicity, socioeconomic position, gender identity, and health disparities. Studies conducted outside of the U.S. in homogenous populations limit generalizability due to differences in food supply and lack of participant diversity.
- Examine dietary patterns with varying amounts of UPF consumed and growth, body composition, and risk of overweight/obesity, across life stages with particular evidence gaps. Limited studies are

[*] A conclusion statement is carefully constructed, based on the evidence reviewed, to answer the systematic review question. A conclusion statement does not draw implications and should not be interpreted as dietary guidance.

available that administer dietary assessments in infants and young children up to age 24 months, adolescents, older adults, and individuals during pregnancy and postpartum.

- Conduct repeat measures of dietary patterns and health outcomes for analyses of longitudinal associations between diet and change in outcomes over time. Studies examining dietary patterns based on a single diet assessment (often at baseline only) and outcome measure do not capture changes in dietary intake and outcomes over time.
- Enhance food surveillance capacity that provides access to the types and amounts of processing ingredients (e.g., emulsifiers, additives, colorants) in food composition databases. Available databases do not provide this information, which limits the ability to understand how and when foods consumed in dietary patterns shift from "processed" to "ultraprocessed."
- Design diet assessment tools specifically to assess varying amounts of UPF within different dietary patterns that are validated for the population of interest (e.g., postpartum). Studies that use dietary intake assessments that were not designed to assess UPF specifically pose higher risk of bias due to potential exposure misclassification.
- Examine dietary patterns with varying amounts of UPF, based on a variety of classification systems (e.g., SIGA), in relation to health outcomes. Studies that use only one classification system (Nova) or no specific classification or definition for UPF limit robustness of the available evidence.
- Quantify the amounts of individual UPF within dietary patterns consumed by participants as total weight (e.g., g/d) and contribution to overall dietary intake (e.g., % energy). Studies that do not provide this context make it difficult to compare UPF intake across studies and define low vs. high amounts of UPF.
- Collect outcome measures of growth, body composition, and obesity in-person, using standardized procedures. Studies that rely on self-report of outcome measures and do not apply standard cut-offs to capture growth, body composition, and risk of obesity pose higher risk of bias due to outcome measurement error and may limit the comparability across findings.
- Assess weight change earlier in pregnancy or preferably pre-pregnancy, rather than from mid- or late-pregnancy. Studies that only examine weight change from mid to late pregnancy may be more prone to error in outcome measurement due to the limited duration of pregnancy.
- Control for key confounding factors, which include: race and/or ethnicity, socioeconomic position, social determinants of health, age, physical activity, anthropometry at baseline, and human milk and infant formula intakes among those under age 2 years. Consider stratifying analyses by those factors and/or other social determinants of health. Studies that do not analyze or adjust for these factors limit the ability to interpret the relationship between dietary patterns consumed and growth, body composition, and risk of obesity.
- Conduct sensitivity analyses by removing individual UPF components within the dietary pattern, particularly those with greater nutrient-density from naturally occurring nutrients, to better determine differences in results. Studies that do not conduct these analyses provide limited information about underlying drivers of the relationship between dietary patterns consumed and growth, body composition, and risk of obesity.
- Report descriptive information on the status of foods/food group items as homemade or commercial/industrialized and rationale for why items may meet classification as "ultra-processed, including the types and amounts of processing "formulations" or specific combinations of ingredients and additives such as emulsifiers and colorants. Studies that do not provide these details limit the ability to determine generalizability across findings.

- Report descriptive information on participant characteristics (e.g., race, ethnicity, health status). Studies that do not provide these details limit the ability to determine generalizability across findings.

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The Committee members are involved in: establishing all aspects of the protocol, which presents the plan for how they are planning to examine the scientific evidence, including the inclusion and exclusion criteria; reviewing all studies that meet the criteria the Committee sets; deliberating on the body of evidence for each question; and writing and grading the conclusion statements. The NESR team, with assistance from Federal staff from HHS and USDA (Jean Altman, MS; Kara Beckman, PhD; Dana DeSilva, PhD, RD; Kevin Kuczynski, MS, RD; TusaRebecca Pannucci, PhD, MPH, RD; Julia Quam, MSPH, RND; Elizabeth Rahavi, RD) and Project Leadership (HHS: Janet de Jesus, MS, RD; USDA: Eve Stoody, PhD), supports the Committee by facilitating, executing, and documenting the work necessary to ensure the reviews are completed in accordance with NESR methodology. Contractor support was also provided by Panum Telecom (Verena McClain, MSc).

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Appendices

Appendix 1: Abbreviations

Table A 1. List of abbreviations

Abbreviation	Full name
BMI	Body mass index
HDI	Human Development Index
HHS	United States Department of Health and Human Services
NESR	Nutrition Evidence Systematic Review
RCT	Randomized controlled trial
SEP	Socioeconomic position
USDA	United States Department of Agriculture
UPF	Ultra-processed food

Appendix 2: Literature search strategy

Search from another systematic review

The search conducted for another review was used to conduct a manual search to identify additional articles. For the complete search documentation, refer to:

Hoelscher DM, Tobias, et al. *Dietary Patterns and Growth, Body Composition, and Risk of Obesity: A Systematic Review* U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2025. https://doi.org/10.52570/NESR.DGAC2025.SR01

Search for the current review

This search was first run on December 16, 2022, and then periodically run using NESR's continuous evidence monitoring methods* until January 2024.

Database: PubMed
Provider: U.S. National Library of Medicine
Date(s) Searched: December 16, 2022 (initial search); December 16, 2022 -January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

* USDA Nutrition Evidence Systematic Review Branch. Chapter 10: Continuous Evidence Monitoring. In: *USDA Nutrition Evidence Systematic Review: Methodology Manual*. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview.

Table A 2. Search for PubMed

Search #	Concept	String
#1	Ultra processed foods	((Fast Foods[MeSH] OR Food Handling[MeSH]) AND process*[tiab]) OR ((ultraprocessed[tiab] OR processed[tiab]) AND (food*[tiab] OR product*[tiab] OR “dietary pattern*”[tiab])) OR “NOVA classification”[tiab] OR “NOVA food”[tiab] OR “NOVA categor*”[tiab] OR (SIGA[tiab] AND (index[tiab] OR classification[tiab] OR algorithm[tiab])) OR "Hyper palatab*"[tiab] OR "Hyperpalatab*"[tiab] OR "highly palatable"[tiab] OR "high palatability"[tiab]
#2	Growth, body composition, and risk of obesity	"Adipose Tissue"[Mesh] OR "Body Composition"[Mesh] OR "Body Weights and Measures"[MeSH:NoExp] OR "Body Fat Distribution"[Mesh] OR "Body Mass Index"[Mesh] OR "Body Size"[Mesh] OR "Skinfold Thickness"[Mesh] OR "Waist-Hip Ratio"[Mesh] OR "Overnutrition"[Mesh] OR "Growth"[Mesh:NoExp] OR anthropometr*[tiab] OR body fat[tiab] OR fat mass[tiab] OR fat free mass[tiab] OR lean mass[tiab] OR obese[tiab] OR obesity[tiab] OR underweight[tiab] OR overweight[tiab] OR weight status[tiab] OR head circumference[tiab] OR arm circumference[tiab] OR calf circumference[tiab] OR neck circumference[tiab] OR thigh circumference[tiab] OR waist circumference[tiab] OR waist to hip ratio[tiab] OR waist hip ratio[tiab] OR body mass index[tiab] OR BMI[tiab] OR adipos*[tiab] OR body weight[tiab] OR body height[tiab] OR body size[tiab] OR body composition[tiab] OR overnutrition[tiab] OR wasting[tiab] OR healthy weight[tiab] OR skin fold[tiab] OR skin folds[tiab] OR skinfold[tiab] OR skinfolds[tiab] OR "Weight Reduction Programs"[Mesh] OR "Body-Weight Trajectory"[Mesh] OR "Weight Gain"[MeSH] OR "Weight Loss"[MeSH:NoExp] OR “Diet, Reducing"[Mesh] OR weight gain*[tiab] OR diet reduc*[tiab] OR weight cycling[tiab] OR weight decreas*[tiab] OR weight watch*[tiab] OR weight control*[tiab] OR weight retention[tiab] OR weight management[tiab] OR (weight[tiab] AND (maint*[tiab] OR reduc*[tiab] OR loss*[tiab] OR chang*[tiab])) OR “Growth Charts”[Mesh] OR growth chart*[tiab]OR stunting[tiab] OR stunted[tiab] OR weight for height[tiab] OR stature for age[tiab] OR weight for age[tiab] OR height for age[tiab] OR length for age[tiab] OR weight for length[tiab] OR failure to thrive[tiab]
#3		#1 AND #2
#4		#3 NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh])) NOT (editorial[ptyp] OR comment[ptyp] OR commentary[tiab] OR news[ptyp] OR letter[ptyp] OR review[ptyp] OR systematic review[ptyp] OR systematic review[ti] OR meta-analysis[ptyp] OR meta-analysis[ti] OR meta-analyses[ti] OR protocol[ti] OR protocols[ti] OR retracted publication[ptyp] OR retraction of publication[ptyp] OR retraction of publication[tiab] OR retraction notice[ti] OR “retracted publication”[ti] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR “conference abstract*”[tiab] OR “conference proceeding*”[tiab] OR “conference paper*”[tiab] OR "practice guideline"[ptyp] OR "practice guideline"[ti]) Filters applied: English, from 2000/1/1 - 3000/12/12.

Database: Embase

Provider: Elsevier
Date(s) Searched: December 16, 2022 (initial search); December 16, 2022 -January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 3. Search for Embase

Search #	Concept	String
#1	Ultra processed foods	'ultra-processed food'/exp OR ('Fast Food'/exp OR 'Food Handling'/exp AND process*:ab,ti) OR ((ultraprocessed OR processed) NEAR/3 (food* OR product* OR 'dietary pattern*')):ab,ti OR 'NOVA classification':ab,ti OR 'NOVA food':ab,ti OR 'NOVA categor*':ab,ti OR ('SIGA' NEAR (index OR classification OR algorithm)):ab,ti OR 'Hyper palatab*':ab,ti OR 'Hyperpalatab*':ab,ti OR 'highly palatable':ab,ti OR 'high palatability':ab,ti
#2	Growth, body composition, and risk of obesity	'adipose tissue'/exp OR 'body composition'/exp OR 'anthropometry'/de OR 'body mass'/exp OR 'anthropometric parameters'/exp OR 'skinfold thickness'/exp OR 'overnutrition'/exp OR 'growth'/de OR 'anthropometr*':ab,ti OR 'body fat':ab,ti OR 'fat mass':ab,ti OR 'fat free mass':ab,ti OR 'lean mass':ab,ti OR 'obese':ab,ti OR 'obesity':ab,ti OR 'underweight':ab,ti OR 'overweight':ab,ti OR 'weight status':ab,ti OR 'head circumference':ab,ti OR 'arm circumference':ab,ti OR 'calf circumference':ab,ti OR 'neck circumference':ab,ti OR 'thigh circumference':ab,ti OR 'waist circumference':ab,ti OR 'waist to hip ratio':ab,ti OR 'waist hip ratio':ab,ti OR 'body mass index':ab,ti OR 'BMI':ab,ti OR 'adipos*':ab,ti OR 'body weight':ab,ti OR 'body height':ab,ti OR 'body size':ab,ti OR 'body composition':ab,ti OR 'overnutrition':ab,ti OR 'wasting':ab,ti OR 'healthy weight':ab,ti OR 'skin fold*':ab,ti OR 'skinfold*':ab,ti OR 'body weight management'/exp OR 'body weight change'/exp OR 'weight gain*':ab,ti OR 'diet reduc*':ab,ti OR 'weight cycling':ab,ti OR 'weight watch*':ab,ti OR 'weight control*':ab,ti OR 'weight retention':ab,ti OR 'weight management':ab,ti OR (weight NEAR/4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*)):ab,ti OR 'weight chart'/exp OR 'growth chart*':ab,ti OR stunting:ab,ti OR stunted:ab,ti OR 'weight for height':ab,ti OR 'stature for age':ab,ti OR 'weight for age':ab,ti OR 'height for age':ab,ti OR 'length for age':ab,ti OR 'weight for length':ab,ti OR ' failure to thrive':ab,ti
#3		#1 AND #2
#4	Limits	#3 AND ([article]/lim OR [article in press]/lim) NOT ([animals]/lim NOT ([animals]/lim AND [humans]/lim)) AND [english]/lim NOT ([conference abstract]/lim OR [conference paper]/lim OR [conference review]/lim OR [editorial]/lim OR [erratum]/lim OR [letter]/lim OR [note]/lim OR 'retraction of publication':ab,ti OR 'retraction notice':ti OR 'retracted publication':ab,ti OR [review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR 'practice guideline':ti) AND [2000-2024]/py

Database: Cochrane Central Register of Controlled Trials (CENTRAL)

Provider: John Wiley & Sons
Date(s) Searched: December 16, 2022 (initial search); December 16, 2022 -January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 4. Search for Cochrane CENTRAL

Search #	Concept	String
#1	Ultra processed foods	(([mh “Fast Foods”] OR [mh “Food Handling”]) AND (process*):ti,ab,kw) OR (((ultraprocessed OR processed) NEAR/3 (food* OR product* OR "dietary pattern" OR "dietary patterns")) OR "NOVA classification" OR "NOVA food" OR "NOVA category" OR "NOVA categories" OR (‘SIGA’ NEAR (index OR classification OR algorithm)) OR "Hyper palatable" OR “hyper palatability” OR Hyperpalat* OR "highly palatable" OR "high palatability"):ti,ab,kw
#2	Growth, body composition, and risk of obesity	([mh "Adipose Tissue"] OR [mh "Body Composition"] OR [mh ^"Body Weights and Measures"] OR [mh "Body Fat Distribution"] OR [mh "Body Mass Index"] OR [mh "Body Size"] OR [mh "Skinfold Thickness"] OR [mh "Waist-Hip Ratio"] OR [mh Overnutrition] OR [mh ^Growth] OR anthropometr* OR “body fat” OR “fat mass” OR “fat free mass” OR “lean mass” OR obese OR obesity OR underweight OR overweight OR “weight status” OR “head circumference” OR “arm circumference” OR “calf circumference” OR “neck circumference” OR “thigh circumference” OR “waist circumference” OR “waist to hip ratio” OR “waist hip ratio” OR “body mass index” OR BMI OR adipos* OR “body weight” OR “body height” OR “body size” OR “body composition” OR overnutrition OR wasting OR “healthy weight” OR “skin fold” OR “skin folds” OR skinfold OR skinfolds):ti,ab,kw OR ([mh "Weight Reduction Programs"] OR [mh "Body-Weight Trajectory"] OR [mh "Weight Gain"] OR [mh ^“Weight Loss”] OR [mh "Diet, Reducing"] OR “diet reduc*” OR “weight cycling” OR “weight watch*” OR “weight control*” OR “weight retention” OR “weight management”):ti,ab,kw OR ((weight NEAR/4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*)) OR [mh “Growth Charts”] OR “growth chart*” OR stunting OR stunted OR “weight for height” OR “stature for age” OR “weight for age” OR “height for age” OR “length for age” OR “weight for length” OR “ failure to thrive”):ti,ab,kw
#3		#1 AND #2 In Trials. Word variations have been searched. Publication Year from 2000 to 2024.

Appendix 3: Excluded articles

The following table lists the articles excluded after full-text screening for this systematic review question. At least one reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

Table A 5. List of excluded articles

Number	Citation	Rationale
1	Acosta-Navarro JC, Oki AM, Antoniazzi L, et al. Consumption of animal-based and processed food associated with cardiovascular risk factors and subclinical atherosclerosis biomarkers in men. Article. Revista da Associacao Medica Brasileira. 2019;65(1):43-50.	Study Design
2	Aguas-Ayesa M, Yarnoz-Esquiroz P, Olazaran L, et al. Evaluation of Dietary and Alcohol Drinking Patterns in Patients with Excess Body Weight in a Spanish Cohort: Impact on Cardiometabolic Risk Factors. Nutrients. Nov 17 2023;15(22)doi:10.3390/nu15224824	Study Design
3	Alae-Carew C, Scheelbeek P, Carrillo-Larco RM, Bernabé-Ortiz A, Checkley W, Miranda JJ. Analysis of dietary patterns and cross-sectional and longitudinal associations with hypertension, high BMI and type 2 diabetes in Peru. Public Health Nutr. Apr 2020;23(6):1009-1019.	Intervention/Exposure
4	Alves-Santos NH, Eshriqui I, Franco-Sena AB, et al. Dietary intake variations from pre-conception to gestational period according to the degree of industrial processing: A Brazilian cohort. Appetite. Oct 1 2016;105:164-71.	Outcome
5	Ambrosini GL, Oddy WH, Robinson M, et al. Adolescent dietary patterns are associated with lifestyle and family psycho-social factors. Public Health Nutr. Oct 2009;12(10):1807-15.	Study Design, Intervention/Exposure
6	Appannah G, Pot GK, Oddy WH, Jebb SA, Ambrosini GL. Determinants of a dietary pattern linked with greater metabolic risk and its tracking during adolescence. J Hum Nutr Diet. Apr 2018;31(2):218-227.	Intervention/Exposure, Outcome
7	Araujo CFDS, Mello JVC, Duque AP, et al. Falta de asociación del fenotipo metabólico con el consumo de alimentos por grado de procesamiento de alimentos: resultados del Estudio de la Salud de los Trabajadores (ESAT). Article in Press. Lack of association between metabolic phenotype and food consumption by degree of food processing: results from the Study of Workers' Health (ESAT). 2022;doi:10.20960/nh.04242	Study Design
8	Baird J, Poole J, Robinson S, et al. Milk feeding and dietary patterns predict weight and fat gains in infancy. Paediatr Perinat Epidemiol. Nov 2008;22(6):575-86.	Intervention/Exposure
9	Barreto J, Assis AMO, e Santana MLP, Pitangueira JCD, Cunha CM, Costa PRF. Influence of sugar consumption from foods with different degrees of processing on anthropometric indicators of children and adolescents after 18 months of follow-up. Br J Nutr. Feb 3 2022:1-11.	Intervention/Exposure
10	Becerra-Tomás N, Babio N, Martínez-González M, et al. Replacing red meat and processed red meat for white meat, fish, legumes or eggs is associated with lower risk of incidence of metabolic syndrome. Clin Nutr. Dec 2016;35(6):1442-1449.	Intervention/Exposure

Number	Citation	Rationale
11	Bell LK, Golley RK, Daniels L, Magarey AM. Dietary patterns of Australian children aged 14 and 24 months, and associations with socio-demographic factors and adiposity. Eur J Clin Nutr. Jun 2013;67(6):638-45.	Study Design, Intervention/Exposure
12	Bielemann RM, Motta JV, Minten GC, Horta BL, Gigante DP. Consumption of ultra-processed foods and their impact on the diet of young adults. Rev Saude Publica. 2015;49:28.	Study Design, Outcome
13	Bonaccio M, Costanzo S, Ruggiero E, et al. Changes in ultra-processed food consumption during the first Italian lockdown following the COVID-19 pandemic and major correlates: results from two population-based cohorts. Public Health Nutr. Aug 2021;24(12):3905-3915.	Study Design
14	Borloz S, Bucher Della Torre S, Collet TH, Jotterand Chaparro C. Consumption of Ultraprocessed Foods in a Sample of Adolescents With Obesity and Its Association With the Food Educational Style of Their Parent: Observational Study. JMIR Pediatr Parent. Nov 15 2021;4(4):e28608.	Study Design, Outcome
15	Brown L, Rose K, Campbell A. Healthy plant-based diets and their short-term effects on weight loss, nutrient intake and serum cholesterol levels. Nutr Bull. Jun 2022;47(2):199-207.	Study Design, Duration, Size of study groups
16	Bull CJ, Northstone K. Childhood dietary patterns and cardiovascular risk factors in adolescence: results from the Avon Longitudinal Study of Parents and Children (ALSPAC) cohort. Public Health Nutr. Dec 2016;19(18):3369-3377.	Intervention/Exposure
17	Byker Shanks C, Vanderwood K, Grocke M, et al. The UnProcessed Pantry Project (UP3): A Community-Based Intervention Aimed to Reduce Ultra-Processed Food Intake Among Food Pantry Clients. Fam Community Health. Jan-Mar 01 2022;45(1):23-33.	Intervention/Exposure
18	Canfi A, Gepner Y, Schwarzfuchs D, et al. Effect of changes in the intake of weight of specific food groups on successful body weight loss during a multi-dietary strategy intervention trial. J Am Coll Nutr. Dec 2011;30(6):491-501.	Intervention/Exposure
19	Canhada SL, Vigo, Levy, et al. Association between ultra-processed food consumption and the incidence of type 2 diabetes: the ELSA-Brasil cohort. Article. Diabetology and Metabolic Syndrome. 2023;15(1)doi:10.1186/s13098-023-01162-2	Outcome
20	Casas R. Moving towards a Healthier Dietary Pattern Free of Ultra-Processed Foods. Article. Nutrients. 2022;14(1)	Study Design, Publication status
21	Celis-Morales C, Livingstone KM, Affleck A, et al. Correlates of overall and central obesity in adults from seven European countries: findings from the Food4Me Study. Eur J Clin Nutr. Feb 2018;72(2):207-219.	Intervention/Exposure
22	Chen F, Huang K, Long Q, et al. Comparative dietary effectiveness of a modified government-recommended diet with avoidance of ultra-processed foods on weight and metabolic management in children and adolescents: An open-label, randomized study. Asia Pac J Clin Nutr. 2022;31(2):282-293.	Intervention/Exposure
23	Cho Y, Ryu S, Kim R, Shin MJ, Oh H. Ultra-processed Food Intake and Risk of Type 2 Diabetes in Korean Adults. J Nutr. Jan 2024;154(1):243-251. doi:10.1016/j.tjnut.2023.11.021	Outcome

Number	Citation	Rationale
24	Colón-Ramos U, Racette SB, Ganiban J, et al. Association between dietary patterns during pregnancy and birth size measures in a diverse population in Southern US. Nutrients. Feb 16 2015;7(2):1318-32.	Intervention/Exposure
25	Cornwell B, Villamor E, Mora-Plazas M, Marin C, Monteiro CA, Baylin A. Processed and ultra-processed foods are associated with lower-quality nutrient profiles in children from Colombia. Public Health Nutr. Jan 2018;21(1):142-147.	Study Design, Outcome
26	Cortes C, Brandao JM, Cunha DB, Paravidino VB, Sichieri R. Blood pressure variation and ultra-processed food consumption in children with obesity. Eur J Pediatr. Sep 2023;182(9):4077-4085. doi:10.1007/s00431-023-05076-z	Outcome
27	Courie R, Gaillard M, Lainas P, et al. Weight outcome after 2 years of a diet that excludes six processed foods: exploratory study of the "1,2,3 diet" in a moderately obese population. Diabetes Metab Syndr Obes. 2018;11:345-355.	Study Design, Intervention/Exposure
28	Cummings JR, Faith MS, Lipsky LM, Liu A, Mooney JT, Nansel TR. Prospective relations of maternal reward-related eating, pregnancy ultra-processed food intake and weight indicators, and feeding mode with infant appetitive traits. Int J Behav Nutr Phys Act. Aug 3 2022;19(1):100.	Intervention/Exposure, Outcome
29	da Silva A, Brum Felício M, Caldas APS, et al. Ultra-processed foods consumption is associated with cardiovascular disease and cardiometabolic risk factors in Brazilians with established cardiovascular events. Int J Food Sci Nutr. Dec 2021;72(8):1128-1137.	Study Design
30	da Silva CL, Sousa AG, Borges LPSL, Costa THM. Usual consumption of ultra-processed foods and its association with sex, age, physical activity, and body mass index in adults living in Brasília city, Brazil. Article. Revista Brasileira de Epidemiologia. 2021;24	Study Design
31	Dalrymple KV, Flynn AC, Seed PT, et al. Associations between dietary patterns, eating behaviours, and body composition and adiposity in 3-year-old children of mothers with obesity. Pediatr Obes. May 2020;15(5):e12608.	Intervention/Exposure
32	Dalrymple KV, Flynn AC, Seed PT, et al. Modifiable early life exposures associated with adiposity and obesity in 3-year old children born to mothers with obesity. Pediatr Obes. Nov 2021;16(11):e12801.	Intervention/Exposure
33	Dalrymple KV, Vogel C, Flynn AC, et al. Longitudinal dietary trajectories from pregnancy to 3 years post delivery in women with obesity: relationships with adiposity. Obesity (Silver Spring). Apr 2023;31(4):1159-1169. doi:10.1002/oby.23706	Intervention/Exposure
34	de Bona Coradi F, Anele CR, Goldani MZ, Silva CH, Bernardi JR. Maternal diet quality and associations with body composition and diet quality of preschool children: A longitudinal study. 18(5)	Intervention/Exposure, Outcome
35	de Melo JMM, Dourado B, e Menezes RCE, Longo-Silva G, Silveira JAC. Early onset of overweight among children from low-income families: The role of exclusive breastfeeding and maternal intake of ultra-processed food. Pediatr Obes. Dec 2021;16(12):e12825.	Intervention/Exposure, Outcome
36	de Paula Mancilha T, Massarani FA, Vieira F, Donangelo CM, Koury JC. Birth weight, skeletal maturity and dietary patterns are associated with body composition compartments differently in male and female physically active adolescents. Nutr Health. May 2 2022:2601060221096514.	Study Design
37	Debras C, Srour B, Chazelas E, et al. Ultra-processed foods and health: Results from the prospective NutriNet-Santé cohort. Article. Cahiers de Nutrition et de Dietetique. 2022;57(3):222-234.	Study Design, Publication language

Number	Citation	Rationale
38	Delisle HF, Vioque J, Gil A. Dietary patterns and quality in West-African immigrants in Madrid. Nutr J. Jan 23 2009;8:3.	Study Design, Intervention/Exposure
39	Detopoulou P, Dedes V, Pylarinou I, Syka D, Tzirogiannis K, Panoutsopoulos GI. Dietary acid load is associated with waist circumference in university students with low adherence to the Mediterranean diet: The potential role of ultra-processed foods. Article. Clinical Nutrition ESPEN. 2023;56:43-51. doi:10.1016/j.clnesp.2023.05.005	Study Design, Intervention/Exposure, Outcome
40	Diethelm K, Günther AL, Schulze MB, Standl M, Heinrich J, Buyken AE. Prospective relevance of dietary patterns at the beginning and during the course of primary school to the development of body composition. Br J Nutr. Apr 28 2014;111(8):1488-98.	Intervention/Exposure
41	Drake I, Sonestedt E, Ericson U, Wallström P, Orho-Melander M. A Western dietary pattern is prospectively associated with cardio-metabolic traits and incidence of the metabolic syndrome. Br J Nutr. May 2018;119(10):1168-1176.	Intervention/Exposure
42	Drehmer M, Odegaard AO, Schmidt MI, et al. Brazilian dietary patterns and the dietary approaches to stop hypertension (DASH) diet-relationship with metabolic syndrome and newly diagnosed diabetes in the ELSA-Brasil study. Article. Diabetology and Metabolic Syndrome. 2017;9(1)	Study Design, Intervention/Exposure
43	Dugee O, Khor GL, Lye MS, et al. Association of major dietary patterns with obesity risk among Mongolian men and women. Asia Pac J Clin Nutr. 2009;18(3):433-40.	Study Design
44	Durán-Agüero S, Valdés-Badilla P, Valladares M, et al. Consumption of ultra-processed food and its association with obesity in Chilean university students: A multi-center study. J Am Coll Health. Sep 1 2021:1-7.	Study Design, Intervention/Exposure
45	Duran-Aguero S, Valdes-Badilla P, Valladares M, et al. Consumption of ultra-processed food and its association with obesity in Chilean university students: A multi-center studyUltra-processed food and obesity in Chilean university students. J Am Coll Health. Nov 2023;71(8):2356-2362. doi:10.1080/07448481.2021.1967960	Study Design
46	Elfassy T, Juul F, Mesa RA, Palaniappan L, Srinivasan M, Yi SS. Associations Between Ultra-processed Food Consumption and Cardiometabolic Health Among Older US Adults: Comparing Older Asian Americans to Older Adults From Other Major Race-Ethnic Groups. Res Aging. Apr 2024;46(3-4):228-240. doi:10.1177/01640275231222928	Study Design
47	Fangupo LJ, Haszard JJ, Taylor BJ, Gray AR, Lawrence JA, Taylor RW. Ultra-Processed Food Intake and Associations With Demographic Factors in Young New Zealand Children. J Acad Nutr Diet. Feb 2021;121(2):305-313.	Intervention/Exposure, Outcome
48	Fazzino TL, Dorling JL, Apolzan JW, Martin CK. Meal composition during an ad libitum buffet meal and longitudinal predictions of weight and percent body fat change: The role of hyper-palatable, energy dense, and ultra-processed foods. Appetite. Dec 1 2021;167:105592.	Intervention/Exposure, Duration
49	Filgueiras AR, Pires de Almeida VB, Koch Nogueira PC, et al. Exploring the consumption of ultra-processed foods and its association with food addiction in overweight children. Appetite. Apr 1 2019;135:137-145.	Study Design
50	Fossee E, Zamora AN, Peterson KE, et al. Prenatal dietary patterns in relation to adolescent offspring adiposity and adipokines in a Mexico City cohort. J Dev Orig Health Dis. Jun 2023;14(3):371-380. doi:10.1017/S2040174422000678	Intervention/Exposure, Outcome

Number	Citation	Rationale
51	Fraga A, Bastos MP, Theme-Filha MM. Increased consumption of ultra-processed foods during pregnancy is associated with sociodemographic, behavioral, and obstetric factors: A cohort study. Nutr Res. Jan 2024;121:28-38. doi:10.1016/j.nutres.2023.10.006	Outcome
52	Gadelha P, e Arruda IKG, Coelho PBP, Queiroz PMA, Maio R, Silva Diniz A. Consumption of ultraprocessed foods, nutritional status, and dyslipidemia in schoolchildren: a cohort study. Eur J Clin Nutr. Aug 2019;73(8):1194-1199.	Study Design, Outcome
53	Gete DG, Waller M, Mishra GD. Prepregnancy dietary patterns and risk of preterm birth and low birth weight: findings from the Australian Longitudinal Study on Women's Health. Am J Clin Nutr. May 1 2020;111(5):1048-1058.	Intervention/Exposure
54	Giacomello L, Bordignon S, Salm D, et al. Effects of the application of a food processing-based classification system in obese women: A randomized controlled pilot study. Article in Press. Nutrition and health. 2023:2601060231153947. doi:10.1177/02601060231153947	Intervention/Exposure, Duration, Size of study groups
55	Gibney MJ. Ultra-processed foods in public health nutrition: the unanswered questions. Journal n/a; Year n/a	Study Design, Publication status
56	Gibney MJ. Ultra-Processed Foods: Definitions and Policy Issues. Curr Dev Nutr. Feb 2019;3(2):nzy077.	Study Design
57	Gomes CB, Malta MB, Benício MHD, Carvalhaes M. Consumption of ultra-processed foods in the third gestational trimester and increased weight gain: a Brazilian cohort study. Public Health Nutr. Aug 2021;24(11):3304-3312.	Outcome
58	Gómez-Donoso C, Martínez-González M, Martínez JA, Sayón-Orea C, e la Fuente-Arrillaga C, Bes-Rastrollo M. Adherence to dietary guidelines for the Spanish population and risk of overweight/obesity in the SUN cohort. PLoS One. 2019;14(12):e0226565.	Intervention/Exposure
59	Gómez-Donoso C, Martínez-González MA, Gea A, Murphy KJ, Parletta N, Bes-Rastrollo M. A food-based score and incidence of overweight/obesity: The Dietary Obesity-Prevention Score (DOS). Clin Nutr. Dec 2019;38(6):2607-2615.	Intervention/Exposure, Overlapping data
60	Grams L, Nelius AK, Pastor GG, et al. Comparison of Adherence to Mediterranean Diet between Spanish and German School-Children and Influence of Gender, Overweight, and Physical Activity. Nutrients. 2022;14(21)	Study Design
61	Grech A, Rangan A, Allman-Farinelli M, Simpson SJ, Gill T, Raubenheimer D. A Comparison of the Australian Dietary Guidelines to the NOVA Classification System in Classifying Foods to Predict Energy Intakes and Body Mass Index. Nutrients. Sep 23 2022;14(19)	Study Design
62	Gyimah EA, Nicholas JL, Waters WF, et al. Ultra-processed foods in a rural Ecuadorian community: associations with child anthropometry and bone maturation. Br J Nutr. Nov 14 2023;130(9):1609-1624. doi:10.1017/S0007114523000624	Study Design
63	H. Al Wattar B D, J P, A B, et al. Mediterranean-style diet in pregnant women with metabolic risk factors (ESTEEM): A pragmatic multicentre randomised trial. PLoS Med. Jul 2019;16(7):e1002857.	Intervention/Exposure
64	Halkjaer J, Tjønneland A, Overvad K, Sørensen TI. Dietary predictors of 5-year changes in waist circumference. J Am Diet Assoc. Aug 2009;109(8):1356-66.	Intervention/Exposure

Number	Citation	Rationale
65	Hall KD, Ayuketah A, Brychta R, et al. Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake. Cell Metab. Jul 2 2019;30(1):67-77.e3.	Duration
66	Handakas E, Chang K, Khandpur N, et al. Metabolic profiles of ultra-processed food consumption and their role in obesity risk in British children. Clin Nutr. Nov 2022;41(11):2537-2548.	Intervention/Exposure, Outcome
67	Heidemann C, Scheidt-Nave C, Richter A, Mensink GB. Dietary patterns are associated with cardiometabolic risk factors in a representative study population of German adults. Br J Nutr. Oct 2011;106(8):1253-62.	Study Design
68	Hinnouho GM, Ferguson EL, MacDougall A, et al. High consumption of unhealthy commercial foods and beverages tracks across the complementary feeding period in rural/peri-urban Cambodia. Matern Child Nutr. Apr 2023;19(2):e13485. doi:10.1111/mcn.13485	Intervention/Exposure, Country
69	Hou M, Qiu C. Ultra-Processed Food as Mediator of the Association between Birthweight and Childhood Body Weight Outcomes: A Retrospective Cohort Study. Nutrients. Oct 2023;15(19)doi:ARTN 4178	Study Design, Outcome
70	Hu T, Jacobs DR, Jr L, N. I C, G. J L, M. N N-S. Higher Diet Quality in Adolescence and Dietary Improvements Are Related to Less Weight Gain During the Transition From Adolescence to Adulthood. J Pediatr. Nov 2016;178:188-193.e3.	Intervention/Exposure
71	Jardí C, Aparicio E, Bedmar C, et al. Food Consumption during Pregnancy and Post-Partum. ECLIPSES Study. Nutrients. Oct 14 2019;11(10)	Intervention/Exposure
72	Jayasinghe SN, Breier BH, McNaughton SA, et al. Dietary Patterns in New Zealand Women: Evaluating Differences in Body Composition and Metabolic Biomarkers. Nutrients. Jul 18 2019;11(7)	Study Design, Intervention/Exposure
73	Joseph P, Franks A, Jaime-Lara R, et al. No significant taste sensitivity or preference differences following AD libitum consumption of ultra-processed and unprocessed diets. Journal article; Conference proceeding. Chemical senses. 2020;45:794-795.	Duration
74	Juul F, Hemmingsson E. Trends in consumption of ultra-processed foods and obesity in Sweden between 1960 and 2010. Public Health Nutr. Dec 2015;18(17):3096-107.	Study Design
75	Juul F, Lin Y, Deierlein AL, Vaidean G, Parekh N. Trends in food consumption by degree of processing and diet quality over 17 years: results from the Framingham Offspring Study. Br J Nutr. Dec 28 2021;126(12):1861-1871.	Outcome
76	Kim Y, Keogh JB, Clifton PM. Differential Effects of Red Meat/Refined Grain Diet and Dairy/Chicken/Nuts/Whole Grain Diet on Glucose, Insulin and Triglyceride in a Randomized Crossover Study. Nutrients. Oct 30 2016;8(11)	Intervention/Exposure, Duration
77	Kim Y, Keogh JB, Clifton PM. Consumption of red and processed meat and refined grains for 4weeks decreases insulin sensitivity in insulin-resistant adults: A randomized crossover study. Metabolism. Mar 2017;68:173-183.	Intervention/Exposure
78	Kim Y, Keogh JB, Clifton PM. Effects of Two Different Dietary Patterns on Inflammatory Markers, Advanced Glycation End Products and Lipids in Subjects without Type 2 Diabetes: A Randomised Crossover Study. Nutrients. Mar 29 2017;9(4)	Intervention/Exposure

Number	Citation	Rationale
79	Konieczna J, Romaguera D, Pereira V, et al. Longitudinal association of changes in diet with changes in body weight and waist circumference in subjects at high cardiovascular risk: the PREDIMED trial. Int J Behav Nutr Phys Act. Dec 27 2019;16(1):139.	Intervention/Exposure
80	Kostecka M, Bojanowska M, Kostecka J, Ciołek A. An analysis of dietary patterns and body composition parameters in the Polish population. Rocz Panstw Zakl Hig. 2021;72(1):55-66.	Study Design
81	Kozioł-Kozakowska A, Kozłowska M, Jagielski P. Assessment of diet quality, nutrient intake, and dietary behaviours in obese children compared to healthy children. Pediatr Endocrinol Diabetes Metab. 2020;26(1):27-38. Ocena jakości diety, spożycia składników odżywczych i zachowań żywieniowych u dzieci otyłych w porównaniu z dziećmi zdrowymi.	Study Design
82	Kurniawan AL, Hsu CY, Lee HA, et al. Comparing two methods for deriving dietary patterns associated with risk of metabolic syndrome among middle-aged and elderly Taiwanese adults with impaired kidney function. Article. BMC medical research methodology. 2020;20(1):255.	Study Design, Intervention/Exposure
83	Lane MM, Lotfaliany M, Hodge AM, et al. High ultra-processed food consumption is associated with elevated psychological distress as an indicator of depression in adults from the Melbourne Collaborative Cohort Study. J Affect Disorders. Aug 15 2023;335:57-66. doi:10.1016/j.jad.2023.04.124	Outcome
84	Lasschuijt M, Camps G, Mars M, Siebelink E, de Graaf K, Bolhuis D. Speed limits: the effects of industrial food processing and food texture on daily energy intake and eating behaviour in healthy adults. Eur J Nutr. Oct 2023;62(7):2949-2962. doi:10.1007/s00394-023-03202-z	Duration
85	Latorre-Millán M, Rupérez AI, González-Gil EM, et al. Dietary Patterns and Their Association with Body Composition and Cardiometabolic Markers in Children and Adolescents: Genobox Cohort. Nutrients. Nov 8 2020;12(11)	Study Design, Intervention/Exposure
86	Lauria F, Dello Russo M, Formisano A, et al. Ultra-processed foods consumption and diet quality of European children, adolescents and adults: Results from the I.Family study. Article. Nutrition, Metabolism and Cardiovascular Diseases. 2021;31(11):3031-3043.	Study Design, Outcome
87	Leblanc V, Hudon AM, Royer MM, et al. Differences between men and women in dietary intakes and metabolic profile in response to a 12-week nutritional intervention promoting the Mediterranean diet. J Nutr Sci. 2015;4:e13.	Intervention/Exposure
88	León-Muñoz LM, García-Esquinas E, López-García E, Banegas JR, Rodríguez-Artalejo F. Major dietary patterns and risk of frailty in older adults: a prospective cohort study. BMC Med. Jan 20 2015;13:11.	Intervention/Exposure, Outcome
89	Lim SX, Cox V, Rodrigues N, et al. Evaluation of Preconception Dietary Patterns in Women Enrolled in a Multisite Study. Curr Dev Nutr. Jul 2022;6(7):nzac106. doi:10.1093/cdn/nzac106	Study Design, Intervention/Exposure
90	Lima BB, Lopes ACS, ior LAA, Lopes MS, Freitas PP, Menezes MC. Effectiveness of the promoting adequate and healthy eating (PAAS) program in primary care: community randomized controlled trial. Article in Press. Journal of Public Health (Germany). 2023;doi:10.1007/s10389-023-02131-9	Intervention/Exposure, Outcome
91	Lioret S, Betoko A, Forhan A, et al. Dietary patterns track from infancy to preschool age: cross-sectional and longitudinal perspectives. Article. J Nutr. Apr 2015;145(4):775-82. doi:10.3945/jn.114.201988	Outcome

Number	Citation	Rationale
92	Lourenco BH, Castro MC, de Morais Sato P, et al. Exposure to ultra-processed foods during pregnancy and ultrasound fetal growth parameters. Br J Nutr. Dec 28 2023;130(12):2136-2145. doi:10.1017/S0007114523001204	Outcome
93	Lourenço BH, Castro MC, Sato PM, et al. Exposure to ultra-processed foods during pregnancy and ultrasound foetal growth parameters.	Outcome
94	Louzada ML, Steele EM, Rezende LFM, Levy RB, Monteiro CA. Changes in Obesity Prevalence Attributable to Ultra-Processed Food Consumption in Brazil Between 2002 and 2009. Int J Public Health. 2022;67:1604103.	Study Design
95	Luque V, Escribano J, Closa-Monasterolo R, et al. Unhealthy Dietary Patterns Established in Infancy Track to Mid-Childhood: The EU Childhood Obesity Project. J Nutr. May 1 2018;148(5):752-759.	Intervention/Exposure
96	Machado PP, Steele EM, Levy RB, et al. Ultra-processed food consumption and obesity in the Australian adult population. Nutr Diabetes. Dec 5 2020;10(1):39.	Study Design
97	Madalosso MM, Martins NNF, Medeiros BM, et al. Consumption of ultra-processed foods and cardiometabolic risk factors in Brazilian adolescents: results from ERICA. Eur J Clin Nutr. Nov 2023;77(11):1084-1092. doi:10.1038/s41430-023-01329-0	Study Design
98	Magalhães E, e Oliveira BR, Rudakoff LCS, et al. Sex-Dependent Effects of the Intake of NOVA Classified Ultra-Processed Foods on Syndrome Metabolic Components in Brazilian Adults. Nutrients. Jul 29 2022;14(15)	Size of study groups
99	Mai TMT, Tran QC, Nambiar S, Gallegos D, Van der Pols JC. Dietary patterns and child, parental, and societal factors associated with being overweight and obesity in Vietnamese children living in Ho Chi Minh city. Article in Press. Maternal & child nutrition. 2023:e13514. doi:10.1111/mcn.13514	Study Design, Country
100	Martin CL, Siega-Riz AM, Sotres-Alvarez D, et al. Maternal Dietary Patterns are Associated with Lower Levels of Cardiometabolic Markers during Pregnancy. Paediatr Perinat Epidemiol. May 2016;30(3):246-55.	Intervention/Exposure
101	Martin CL, Siega-Riz AM, Sotres-Alvarez D, et al. Maternal Dietary Patterns during Pregnancy Are Associated with Child Growth in the First 3 Years of Life. J Nutr. Nov 2016;146(11):2281-2288.	Intervention/Exposure
102	Martinez-Perez C, San-Cristobal R, Guallar-Castillon P, et al. Use of Different Food Classification Systems to Assess the Association between Ultra-Processed Food Consumption and Cardiometabolic Health in an Elderly Population with Metabolic Syndrome (PREDIMED-Plus Cohort). Nutrients. Jul 20 2021;13(7)	Study Design
103	Martins AP, Benicio MH. Influence of dietary intake during gestation on postpartum weight retention. Rev Saude Publica. Oct 2011;45(5):870-7.	Intervention/Exposure, Publication language
104	Mattei J, Noel SE, Tucker KL. A meat, processed meat, and French fries dietary pattern is associated with high allostatic load in Puerto Rican older adults. J Am Diet Assoc. Oct 2011;111(10):1498-506.	Intervention/Exposure, Outcome
105	Mertens E, Colizzi C, Peñalvo JL. Ultra-processed food consumption in adults across Europe. Eur J Nutr. Apr 2022;61(3):1521-1539.	Study Design

Number	Citation	Rationale
106	Mertens E, Markey O, Geleijnse JM, Givens DI, Lovegrove JA. Dietary Patterns in Relation to Cardiovascular Disease Incidence and Risk Markers in a Middle-Aged British Male Population: Data from the Caerphilly Prospective Study. Nutrients. Jan 18 2017;9(1)	Intervention/Exposure, Outcome
107	Mikeš O, Brantsæter AL, Knutsen HK, et al. Dietary patterns and birth outcomes in the ELSPAC pregnancy cohort. J Epidemiol Community Health. Jun 2022;76(6):613-619.	Intervention/Exposure, Outcome
108	Morris TT, Northstone K. Rurality and dietary patterns: associations in a UK cohort study of 10-year-old children. Public Health Nutr. Jun 2015;18(8):1436-43.	Study Design, Outcome
109	Moubarac JC, Martins AP, Claro RM, Levy RB, Cannon G, Monteiro CA. Consumption of ultra-processed foods and likely impact on human health. Evidence from Canada. Public Health Nutr. Dec 2013;16(12):2240-8.	Study Design, Outcome
110	Mullen A. Ultraprocessed food and cardiometabolic disease. Article. Nature Food. 2021;2(8):554. doi:10.1038/s43016-021-00355-0	Study Design , Publication status
111	Muslimatun S, Wiradnyani LA. Dietary diversity, animal source food consumption and linear growth among children aged 1-5 years in Bandung, Indonesia: a longitudinal observational study. Br J Nutr. Jul 2016;116 Suppl 1:S27-35.	Intervention/Exposure, Country
112	Nardocci M, Leclerc BS, Louzada ML, Monteiro CA, Batal M, Moubarac JC. Correction to: Consumption of ultra-processed foods and obesity in Canada. Can J Public Health. Feb 2019;110(1):15-16.	Study Design , Publication status
113	Neri D, Steele EM, Khandpur N, et al. Ultraprocessed food consumption and dietary nutrient profiles associated with obesity: A multicountry study of children and adolescents. Obes Rev. Jan 2022;23 Suppl 1:e13387.	Study Design, Outcome
114	Nettleton JA, Follis JL, Ngwa JS, et al. Gene × dietary pattern interactions in obesity: analysis of up to 68 317 adults of European ancestry. Hum Mol Genet. Aug 15 2015;24(16):4728-38.	Intervention/Exposure
115	Nettleton JA, Schulze MB, Jiang R, Jenny NS, Burke GL, Jacobs DR. A priori-defined dietary patterns and markers of cardiovascular disease risk in the Multi-Ethnic Study of Atherosclerosis (MESA). Am J Clin Nutr. Jul 2008;88(1):185-94.	Study Design, Intervention/Exposure
116	Neves AM, Madruga SW. Complementary feeding, consumption of industrialized foods and nutritional status of children under 3 years old in Pelotas, Rio Grande do Sul, Brazil, 2016: a descriptive study. Epidemiol Serv Saude. 2019;28(1):e2017507. Alimentação complementar, consumo de alimentos industrializados e estado nutricional de crianças menores de 3 anos em Pelotas, Rio Grande do Sul, Brasil, 2016: um estudo descritivo.	Study Design
117	Newby PK, Muller D, Hallfrisch J, Qiao N, Andres R, Tucker KL. Dietary patterns and changes in body mass index and waist circumference in adults. Am J Clin Nutr. Jun 2003;77(6):1417-25.	Intervention/Exposure
118	Ng CM, Kaur S, Koo HC, Mukhtar F, Yim HS. Experiential healthy meal preparation: A randomized-controlled trial to improve food group consumption and weight status among children. Article. Human Nutrition and Metabolism. 2022;28	Intervention/Exposure

Number	Citation	Rationale
119	Nogueira MB, Mazzucchetti L, Mosquera PS, Cardoso MA, Malta MB. Consumption of ultra-processed foods during the first year of life and associated factors in Cruzeiro do Sul, Brazil. Article. Ciencia e Saude Coletiva. 2022;27(2):725-736.	Outcome
120	Northstone K, Emmett P, Rogers I. Dietary patterns in pregnancy and associations with socio-demographic and lifestyle factors. Eur J Clin Nutr. Apr 2008;62(4):471-9.	Study Design, Outcome
121	Northstone K, Smith AD, Newby PK, Emmett PM. Longitudinal comparisons of dietary patterns derived by cluster analysis in 7- to 13-year-old children. Br J Nutr. Jun 2013;109(11):2050-8.	Study Design, Outcome
122	O'Connor LE, Hall KD, Herrick KA, et al. Metabolomic Profiling of an Ultraprocessed Dietary Pattern in a Domiciled Randomized Controlled Crossover Feeding Trial. J Nutr. Aug 2023;153(8):2181-2192. doi:10.1016/j.tjnut.2023.06.003	Duration
123	Oddo VM, Maehara M, Rah JH. Overweight in Indonesia: an observational study of trends and risk factors among adults and children. BMJ Open. Sep 27 2019;9(9):e031198.	Intervention/Exposure, Country
124	Pala V, Sieri S, Masala G, et al. Associations between dietary pattern and lifestyle, anthropometry and other health indicators in the elderly participants of the EPIC-Italy cohort. Nutr Metab Cardiovasc Dis. Apr 2006;16(3):186-201.	Intervention/Exposure
125	Pan F, Wang ZH, Wang HJ, et al. Association between Ultra-Processed Food Consumption and Metabolic Syndrome among Adults in China-Results from the China Health and Nutrition Survey. Nutrients. Feb 2023;15(3)doi:ARTN 75210.3390/nu15030752	Study Design
126	Pan F, Zhang T, Mao W, Zhao F, Luan D, Li J. Ultra-Processed Food Consumption and Risk of Overweight or Obesity in Chinese Adults: Chinese Food Consumption Survey 2017-2020. Nutrients. Sep 16 2023;15(18)doi:10.3390/nu15184005	Study Design
127	Pang T, Alman AC, Gray HL, Basu A, Shi L, Snell-Bergeon JK. Empirical dietary inflammatory pattern and metabolic syndrome: prospective association in participants with and without type 1 diabetes mellitus in the coronary artery calcification in type 1 diabetes (CACTI) study. Nutr Res. Oct 2021;94:1-9.	Size of study groups
128	Pang TT, Gray HL, Alman AC, et al. Ultra-processed food consumption and obesity indicators in individuals with and without type 1 diabetes mellitus: a longitudinal analysis of the prospective Coronary Artery Calcification in Type 1 Diabetes (CACTI) cohort study. Public Health Nutrition. Aug 2023;26(8):1626-1633. doi:Pii S1368980023000848	Intervention/Exposure, Size of study groups
129	Papagianni O, Maniati E, Pegkos A, et al. Association between functional and novel food consumption frequency and obesity anthropometric indexes, in a sample of healthy volunteers: a retro prospective study. Journal article; Conference proceeding. Obesity facts. 2021;14(SUPPL 1):174-175.doi:10.1017/S1368980023000848	Intervention/Exposure Publication status
130	Pereira AM, Buffarini R, Domingues MR, Barros F, Silveira MFD. Ultra-processed food consumption by children from a Pelotas Birth Cohort. Rev Saude Publica. 2022;56:79.	Study Design, Outcome
131	Pereyra-González I, Mattei J. Combined intake of sugar-sweetened beverages and sugar-containing ultra-processed foods is associated with an increase in body mass index during early childhood.	Intervention/Exposure

Number	Citation	Rationale
132	Perez-Escamilla R. Ultra-processed foods and the nutritional transition among infants and young children: a radiography from Brazil. Article. Alimentos ultraprocessados e a transi??o nutricional em beb?s e crian?as pequenas: uma radiografia do Brasil. 2023;39doi:10.1590/0102-311XEN118123	Study Design, Publication status
133	Philip Karl J, Armstrong NJ, Player RA, Rood JC, Soares JW, McClung HL. The Fecal Metabolome Links Diet Composition, Foacidic positive ion conditions, chromatographicallyod Processing, and the Gut Microbiota to Gastrointestinal Health in a Randomized Trial of Adults Consuming a Processed Diet. Article. Journal of Nutrition. 2022;152(11):2343-2357. doi:10.1093/jn/nxac161	Duration
134	Phillips NE, Mareschal J, Schwab N, et al. The Effects of Time-Restricted Eating versus Standard Dietary Advice on Weight, Metabolic Health and the Consumption of Processed Food: a Pragmatic Randomised Controlled Trial in Community-Based Adults. Journal Article; Clinical Trial Protocol. Nutrients. 2021;13(3)	Intervention/Exposure, Duration
135	Pinto A, Santos AC, Lopes C, Oliveira A. Dietary patterns at 7 year-old and their association with cardiometabolic health at 10 year-old. Clin Nutr. Apr 2020;39(4):1195-1202.	Intervention/Exposure
136	Pinto A, Severo M, Oliveira A. Use of a hybrid method to derive dietary patterns in 7 years olds with explanatory ability of body mass index at age 10. Eur J Clin Nutr. Nov 2021;75(11):1598-1606.	Intervention/Exposure
137	Poll FA, Miraglia F, D'Avila H F, Reuter CP, Mello ED. Impact of intervention on nutritional status, consumption of processed foods, and quality of life of adolescents with excess weight. J Pediatr (Rio J). Sep-Oct 2020;96(5):621-629.	Intervention/Exposure, Outcome
138	Pou SA, Del Pilar Díaz M, De La Quintana AG, Forte CA, Aballay LR. Identification of dietary patterns in urban population of Argentina: study on diet-obesity relation in population-based prevalence study. Nutr Res Pract. Dec 2016;10(6):616-622.	Study Design, Intervention/Exposure
139	Raspini B, Prosperi M, Guiducci L, et al. Dietary Patterns and Weight Status in Italian Preschoolers with Autism Spectrum Disorder and Typically Developing Children. Nutrients. Nov 12 2021;13(11)	Study Design, Intervention/Exposure
140	Rauber F, Campagnolo PDB, Hoffman DJ, Vitolo MR. Consumption of ultra-processed food products and its effects on children's lipid profiles: A longitudinal study. Article. Nutrition, Metabolism and Cardiovascular Diseases. 2015;25(1):116-122.	Outcome
141	Rauber F, Steele EM, Costa Louzada ML, Millett C, Monteiro CA, Levy RB. Ultra-processed food consumption and indicators of obesity in the United Kingdom population (2008-2016). Article. PLoS ONE. 2020;15(5)	Study Design
142	Razmpoosh E, Zare S, Fallahzadeh H, Safi S, Nadjarzadeh A. Effect of a low energy diet, containing a high protein, probiotic condensed yogurt, on biochemical and anthropometric measurements among women with overweight/obesity: A randomised controlled trial. Clin Nutr ESPEN. Feb 2020;35:194-200.	Intervention/Exposure, Duration
143	Ribeiro IDC, Santos de Almeida Oliveira TLP, Santos GCJ, et al. Daily consumption of ultra-processed foods and cardiometabolic risk factors in children aged 7 to 10 years in Northeast Brazil. Article in Press. Nutrition and health. 2022:2601060221084816.	Study Design
144	Riboldi BP, Luft VC, Bracco PA, et al. The inflammatory food index and its association with weight gain and incidence of diabetes: Longitudinal Study of Adult Health (ELSA-Brasil). Nutr Metab Cardiovasc Dis. Mar 2022;32(3):675-683.	Intervention/Exposure, Overlapping data

Number	Citation	Rationale
145	Romaguera D, Ängquist L, Du H, et al. Food composition of the diet in relation to changes in waist circumference adjusted for body mass index. PLoS One. 2011;6(8):e23384.	Intervention/Exposure
146	Rosignoli da Conceição A, Silva A, Marcadenti A, Bersch-Ferreira Â C, Weber B, Bressan J. Consumption of unprocessed or minimally processed foods and their association with cardiovascular events and cardiometabolic risk factors in Brazilians with established cardiovascular events.	Health Status, Study Design
147	Ryman TK, Boyer BB, Hopkins S, et al. Associations between diet and cardiometabolic risk among Yup'ik Alaska Native people using food frequency questionnaire dietary patterns. Nutr Metab Cardiovasc Dis. Dec 2015;25(12):1140-5.	Study Design
148	Saldanha-Gomes C, Hallimat Cissé A, Descarpentrie A, et al. Prospective associations between dietary patterns, screen and outdoor play times at 2 years and age at adiposity rebound: The EDEN mother-child cohort. Prev Med Rep. Feb 2022;25:101666.	Intervention/Exposure
149	Salvesen L, Valen EN, Wills AK, et al. Developmental origins of health and disease knowledge is associated with diet quality in preconception young adult men and women. J Dev Orig Hlth Dis. Oct 2023;14(5):631-638. doi:10.1017/S2040174423000314	Study Design, Intervention/Exposure, Outcome
150	Sandoval-Insausti H, Blanco-Rojo R, Graciani A, et al. Ultra-processed Food Consumption and Incident Frailty: A Prospective Cohort Study of Older Adults. J Gerontol A Biol Sci Med Sci. May 22 2020;75(6):1126-1133.	Outcome
151	Sandoval-Insausti H, Jiménez-Onsurbe M, Donat-Vargas C, et al. Ultra-Processed Food Consumption Is Associated with Abdominal Obesity: A Prospective Cohort Study in Older Adults. Nutrients. Aug 7 2020;12(8)	Size of study groups
152	Santos LP, Assunção MC, Matijasevich A, Santos IS, Barros AJ. Dietary intake patterns of children aged 6 years and their association with socioeconomic and demographic characteristics, early feeding practices and body mass index. Article. BMC public health. 2016;16(1):1055.	Study Design, Intervention/Exposure
153	Sartorelli DS, Crivellenti LC, Baroni NF, et al. Effectiveness of a minimally processed food-based nutritional counselling intervention on weight gain in overweight pregnant women: a randomized controlled trial. Eur J Nutr. Sep 10 2022:1-12.	Intervention/Exposure
154	Schnabel L, Buscail C, Sabate JM, et al. Association Between Ultra-Processed Food Consumption and Functional Gastrointestinal Disorders: Results From the French NutriNet-Santé Cohort. Am J Gastroenterol. Aug 2018;113(8):1217-1228.	Study Design, Outcome
155	Schneider BC, Dumith Sde C, Lopes C, Severo M, Assunção MC. How Do Tracking and Changes in Dietary Pattern during Adolescence Relate to the Amount of Body Fat in Early Adulthood? PLoS One. 2016;11(2):e0149299.	Intervention/Exposure
156	Schulz M, Nöthlings U, Hoffmann K, Bergmann MM, Boeing H. Identification of a food pattern characterized by high-fiber and low-fat food choices associated with low prospective weight change in the EPIC-Potsdam cohort. J Nutr. May 2005;135(5):1183-9.	Intervention/Exposure
157	Schulze MB, Fung TT, Manson JE, Willett WC, Hu FB. Dietary patterns and changes in body weight in women. Obesity (Silver Spring). Aug 2006;14(8):1444-53.	Intervention/Exposure

Number	Citation	Rationale
158	Sciarrillo CM, Guo J, Hengist A, Darcey VL, Hall KD. Diet order affects energy balance in randomized crossover feeding studies that vary in macronutrients but not ultra-processing.	Duration
159	Seale E, Greene-Finestone LS, e Groh M. Examining the diversity of ultra-processed food consumption and associated factors in Canadian adults. Appl Physiol Nutr Metab. Aug 2020;45(8):857-864.	Study Design
160	Shah RV, Murthy VL, Allison MA, et al. Diet and adipose tissue distributions: The Multi-Ethnic Study of Atherosclerosis. Nutr Metab Cardiovasc Dis. Mar 2016;26(3):185-93.	Intervention/Exposure
161	Sherafat-Kazemzadeh R, Egtesadi S, Mirmiran P, et al. Dietary patterns by reduced rank regression predicting changes in obesity indices in a cohort study: Tehran Lipid and Glucose Study. Asia Pac J Clin Nutr. 2010;19(1):22-32.	Intervention/Exposure
162	Shim JS, Ha KH, Kim DJ, Kim HC. Ultra-Processed Food Consumption and Obesity in Korean Adults. Diabetes Metab J. Jul 2023;47(4):547-558. doi:10.4093/dmj.2022.0026	Study Design
163	Shim JS, Ha KH, Kim DJ, Kim HC. Diet quality partially mediates the association between ultraprocessed food consumption and adiposity indicators. Article in Press. Obesity (Silver Spring, Md). 2023;doi:10.1002/oby.23853	Study Design
164	Shim SY, Kim HC, Shim JS. Consumption of Ultra-Processed Food and Blood Pressure in Korean Adults. Korean Circ J. Jan 2022;52(1):60-70.	Study Design
165	Silva Dos Santos F, Costa Mintem G, e Oliveira IO, et al. Consumption of ultra-processed foods and interleukin-6 in two cohorts from high- and middle-income countries. Br J Nutr. Feb 21 2022:1-28.doi:10.1017/S0007114522000551	Outcome
166	Silva CFM, Saunders C, Peres W, et al. Effect of ultra-processed foods consumption on glycemic control and gestational weight gain in pregnant with pregestational diabetes mellitus using carbohydrate counting. PeerJ. 2021;9:e10514.	Health Status
167	Smit AJP, Hojeij B, Rousian M, et al. A high periconceptional maternal ultra-processed food consumption impairs embryonic growth: The Rotterdam periconceptional cohort. Clin Nutr. Aug 2022;41(8):1667-1675.	Outcome
168	Smith AD, Emmett PM, Newby PK, Northstone K. Dietary patterns and changes in body composition in children between 9 and 11 years. Food Nutr Res. 2014;58	Intervention/Exposure
169	Steffen LM, Van Horn L, Daviglus ML, et al. A modified Mediterranean diet score is associated with a lower risk of incident metabolic syndrome over 25 years among young adults: the CARDIA (Coronary Artery Risk Development in Young Adults) study. Br J Nutr. Nov 28 2014;112(10):1654-61.	Intervention/Exposure
170	Sterling S, Bertrand B, Judd S, Carson TL, Chandler-Laney P, Baskin ML. Longitudinal Analysis of Nut-Inclusive Diets and Body Mass Index Among Overweight and Obese African American Women Living in Rural Alabama and Mississippi, 2011-2013. Prev Chronic Dis. Sep 21 2017;14:E82.	Intervention/Exposure

Number	Citation	Rationale
171	Sterling S, Judd S, Bertrand B, Carson TL, Chandler-Laney P, Baskin ML. Dietary Patterns Among Overweight and Obese African-American Women Living in the Rural South. J Racial Ethn Health Disparities. Feb 2018;5(1):141-150.	Study Design, Intervention/Exposure
172	Strathearn L, Kaçar HK, Avery A. Changes in dietary patterns when females engage in a weight management programme and their ability to meet Scientific Advisory Committee on Nutrition's fibre and sugar recommendations. Public Health Nutr. Aug 2020;23(12):2189-2198.	Study Design, Intervention/Exposure Duration
173	Teixeira JA, Hoffman DJ, Castro TG, et al. Pre-pregnancy dietary pattern is associated with newborn size: results from ProcriAr study. Br J Nutr. Sep 28 2021;126(6):903-912.	Intervention/Exposure, Outcome
174	Thorning TK, Raziani F, Bendsen NT, Astrup A, Tholstrup T, Raben A. Diets with high-fat cheese, high-fat meat, or carbohydrate on cardiovascular risk markers in overweight postmenopausal women: a randomized crossover trial. Am J Clin Nutr. Sep 2015;102(3):573-81.	Intervention/Exposure, Duration Size of study groups
175	Ushula TW, Mamun A, Darssan D, et al. Dietary patterns and the risks of metabolic syndrome and insulin resistance among young adults: Evidence from a longitudinal study. Clin Nutr. Jul 2022;41(7):1523-1531.	Intervention/Exposure, Outcome
176	Valmorbida JL, Baratto PS, Leffa PS, Sangalli CN, Silva JA, Vitolo MR. Consumption of ultraprocessed food is associated with higher blood pressure among 6-year-old children from southern Brazil. Nutrition Research. Aug 2023;116:60-68. doi:10.1016/j.nutres.2023.05.012	Outcome
177	Vandevijvere S, De Ridder K, Fiolet T, Bel S, Tafforeau J. Consumption of ultra-processed food products and diet quality among children, adolescents and adults in Belgium. Article. European Journal of Nutrition. 2019;58(8):3267-3278.	Study Design, Outcome
178	Vang A, Singh PN, Lee JW, Haddad EH, Brinegar CH. Meats, processed meats, obesity, weight gain and occurrence of diabetes among adults: findings from Adventist Health Studies. Ann Nutr Metab. 2008;52(2):96-104.	Intervention/Exposure, Outcome
179	Veum VL, Laupsa-Borge J, Eng Ø, et al. Visceral adiposity and metabolic syndrome after very high-fat and low-fat isocaloric diets: a randomized controlled trial. Journal Article; Clinical Trial Protocol. American journal of clinical nutrition. 2017;105(1):85-99.	Intervention/Exposure
180	Wang Y, Lindemann SR, Cross TL, Tang M, Clark CM, Campbell WW. Effects of Adding Lean Red Meat to a U.S.-Style Healthy Vegetarian Dietary Pattern on Gut Microbiota and Cardiovascular Risk Factors in Young Adults: a Crossover Randomized Controlled Trial. J Nutr. May 2023;153(5):1439-1452. doi:10.1016/j.tjnut.2023.03.013	Intervention/Exposure Duration Size of study groups
181	Wang Y, Dai Y, Tian T, et al. The effects of dietary pattern on metabolic syndrome in jiangsu province of china: Based on a nutrition and diet investigation project in Jiangsu province. Article. Nutrients. 2021;13(12)	Study Design
182	Wang Y, Wang K, Du M, et al. Maternal consumption of ultra-processed foods and subsequent risk of offspring overweight or obesity: Results from three prospective cohort studies. Article in Press. The BMJ. 2022;doi:10.1136/bmj-2022-071767	Intervention/Exposure, Outcome
183	Weigel MM, Armijos RX. The Ecuadorian School Food Environment: Association With Healthy and Unhealthy Food and Beverage Consumption and BMI. Food Nutr Bull. Dec 2022;43(4):439-464.	Study Design

Number	Citation	Rationale
184	Wen LM, Simpson JM, Rissel C, Baur LA. Maternal "junk food" diet during pregnancy as a predictor of high birthweight: findings from the healthy beginnings trial. Birth. Mar 2013;40(1):46-51.	Intervention/Exposure, Outcome
185	Winkvist A, Klingberg S, Nilsson LM, et al. Longitudinal 10-year changes in dietary intake and associations with cardio-metabolic risk factors in the Northern Sweden Health and Disease Study. Nutr J. Mar 28 2017;16(1):20.	Intervention/Exposure
186	Woolhead C, Walsh MC, Gibney MJ, et al. Dietary patterns in Europe: the Food4Me proof of principle study. Journal article; Conference proceeding. Proceedings of the Nutrition Society. 2015;74(OCE4)	Publication status
187	Wosje KS, Khoury PR, Claytor RP, et al. Dietary patterns associated with fat and bone mass in young children. Am J Clin Nutr. Aug 2010;92(2):294-303.	Intervention/Exposure
188	Wrottesley SV, Prioreschi A, Kehoe SH, Ward KA, Norris SA. A maternal "mixed, high sugar" dietary pattern is associated with fetal growth. Matern Child Nutr. Apr 2020;16(2):e12912.	Intervention/Exposure, Country
189	Yong HY, Shariff ZM, Mohd Yusof BN, et al. Associations between the dietary patterns of pregnant Malaysian women and ethnicity, education, and early pregnancy waist circumference: A prospective cohort study. Nutr Res Pract. Jun 2019;13(3):230-239.	Intervention/Exposure
190	Zhen S, Ma Y, Zhao Z, Yang X, Wen D. Dietary pattern is associated with obesity in Chinese children and adolescents: data from China Health and Nutrition Survey (CHNS). Nutr J. Jul 11 2018;17(1):68.	Intervention/Exposure, Country
191	Zhou Y, Du S, Su C, Zhang B, Wang H, Popkin BM. The food retail revolution in China and its association with diet and health. Food Policy. Aug 1 2015;55:92-100.	Study Design, Intervention/Exposure